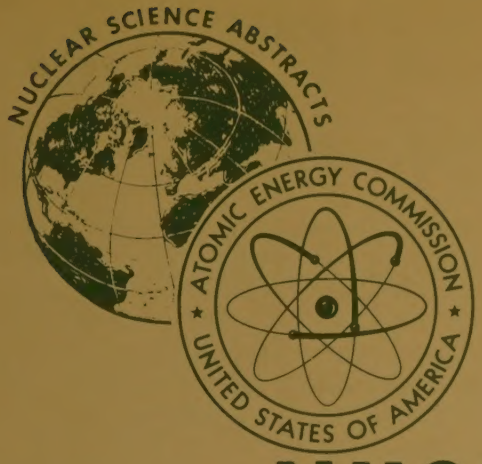

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Volume 15 Number 13

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July 15, 1961

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Volume 15, Number 13 July 15, 1961

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Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

16773 (LMSD-895070) LMSD GENERAL RESEARCH ANNUAL REPORT, 1960. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Mar. 1961. 112p.

The scientific work carried out under the Lockheed Missiles and Space Division's General Research Program covering the areas of physics, flight sciences, chemistry, mathematics, and communications is summarized. Basic research was carried out on nuclear physics, radiation physics, space physics, ionic physics, solid-state physics, electromagnetics, gas dynamics, aerothermodynamics, structural mechanics, materials chemistry, metallurgy, propulsion chemistry, electrochemistry, pure mathematics, analytical mechanics and dynamics, automata studies, electronic communications, fluid properties, and optics. Applied research on space flight, plasma propulsion, geophysical payload, thermionic power conversion, chemistry and combustion, explosive forming, high-strength steel, thin-film studies, oceanographic measuring systems, communications systems, semiconductory circuity, modular code communications, solid-state microwave switching, recognition of space objects, high-speed digital circuitry, automatic optimization of logic, machine language translation, infrared experimentation, anodic oxidation of metal surfaces, space vehicle tracking, ionization produced by re-entry vehicles, and hemispherical antenna investigation is discussed. (M.C.G.)

16774 (NASA-TN-D-766) PERFORMANCE EVALUATION OF A TWO-DIMENSIONAL ION ROCKET USING THROUGH-FEED AND POROUS TUNGSTEN IONIZERS. David L. Lockwood and Ronald J. Cybulski (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1961. 53p.

An ion rocket producing a nearly two-dimensional ion beam was operated with two ionizers. Each ionizer is examined, and a comparison is made between the respective performances. Data show that the porous tungsten ionizer is superior to the through-feed ionizer. Accelerator and power efficiencies to 98 and 53%, respectively, were obtained with this ion rocket at current densities to 89 amp/sq m. The power efficiency was obtained at a specific impulse of 12,300 sec. Preliminary data are presented which show the effect of electron addition on ion-beam divergence. A direct comparison is made between metered data and independent hot-wire calorimeter data. (auth)

16775 (TID-11404) IAEA RESEARCH PROJECTS. (Atomic Energy Commission, Washington, D. C.). [1961]. 17p.

Research contracts which were awarded and renewed by the IAEA up to Dec. 31, 1960, are described under the following headings: safe disposal of radioactive waste, health physics and radiation protection, radiobiology, safeguards, power reactor studies, applications of radioisotopes in medicine and in agriculture, and miscellaneous. The contracts total 100 in number. Breakdowns of the contract costs and distribution are presented in terms of country and subject, and comparisons with other years are given. (D.L.C.)

16776 FISSION PRODUCTS AS SOURCES OF RADIATION. S. Jefferson, F. Rogers, and G. S. Murray (Wantage Radiation Lab., Berks, Eng.). p.351-70 of "Atomic Energy Waste. Its Nature, Uses and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Applications of fission products as sources of radiation are surveyed. Topics discussed include reactor core radiation; indirect reactor radiation; the separation of active fission products and their use as radiation sources; the use of irradiated fuel elements as radiation sources; the preparation of radiation sources from concentrated raffinate resulting from processing spent reactor fuel elements; the separation of long-lived fission products, such as Cs^{137} and Sr^{90}, and their fabrication as sealed radiation sources; the preparation of Co^{60} sources; the design of irradiation units using γ sources; and applications of γ sources in the radiation processing of foods, pharmaceuticals, and medical supplies. A design is included for a package irradiation plant. (C.H.)

16777 FRONTIERS IN ATOMIC ENERGY RESEARCH. SUMMARY-ANALYSIS OF HEARINGS HELD ON MARCH 22, 23, 24, AND 25, 1960, BEFORE THE SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. (United States. Congress. Joint Committee on Atomic Energy). Aug. 1960. 22p.

16778 HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, SECOND SESSION ON FRONTIERS IN ATOMIC ENERGY RESEARCH, MARCH 22, 23, 24, AND 25, 1960. (United States. Congress. Joint Committee on Atomic Energy). 386p.

Aspects of Plowshare Project were reported, including research developments, chemical and isotope production, mineral recovery (tar sands, oil shales, and mining uses), energy production and recovery (e.g., controlled release of energy from salt melted during nuclear explosion), and ex-

cavation uses of atomic explosions. The purposes and types of machines used in Sherwood Project were reviewed, and developments at Los Alamos, UCRL, Oak Ridge, and Princeton were examined. Advantages of nuclear energy over conventional energy were listed, i.e., economy in mining of the fuel, compactness of the fuel, waste controllability, sharp and controllable energy output pulses, ionization, breeding, high temperatures, and research. Reactor applications for chemical production and coal studies were described. The Rover and Orion Projects were reviewed, and advances in SNAP power sources were noted. Direct conversion concepts and programs; including thermionic, photoelectric, and thermoelectric cells were described. Uses of these devices for solar energy applications in industry, in the United States and in underdeveloped countries, were suggested. (T.F.H.)

16779 NUCLEAR FRONTIERS—1960. A FORUM REPORT (No. 32). Proceedings of the Annual Conference for Members and Guests, San Francisco, California, December 14-16, 1960. Edwin A. Wiggin, ed. New York, Atomic Industrial Forum, Inc. 1961. 336p. $10.00

Forty six papers are included. Nuclear aspects of space exploration are described, including government contracting policies and industry participation, SNAP program, Rover program, space safety, management and objectives, and social implications. Uranium production, processing, and forecasted needs are discussed. The present and future status of IAEA is outlined; legal problems are examined in international atomic energy contracts, such as roles of the U. S. and foreign governments in these contracts, and vehicles for transacting the contracts abroad. Foreign nuclear development programs (Indatom, OEEC, Euratom, and Belgian, French, and Japanese programs) are outlined. The cooperation necessary between federal and state governments in domestic atomic energy activities is discussed. The AEC's effects on industry, including reactor licensing procedures, patent rights of contractors, promotional and regulatory functions, and government supports, are reviewed. Problems involved in gaining public acceptance and understanding of atomic activities are described. Problems involved in initiating a power reactor project are studied; these problems include siting, safety, official approval, and private utility aspects. Economic aspects, reprocessing and transportation methods, and selection of fuel clad and matrix materials for reactor fuels are discussed. The Texas program, pulsed reactors, direct conversion methods, and fissio-chemical reactor potentials are analyzed; new radiation and radioisotope applications are discussed. (T.F.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

16780 (ABCC-00-59) BIBLIOGRAPHY OF PUBLISHED PAPERS OF THE ATOMIC BOMB CASUALTY COMMISSION (1947-1959). (Atomic Bomb Casualty Commission, Hiroshima). 19p.

References to 193 publications by staff members of the Atomic Bomb Casualty Commission during 1957 through 1959 are listed in both English and Japanese. Author and subject indexes are included. (C.H.)

16781 (TID-12586) BIBLIOGRAPHY OF ABCC PUBLICATIONS 1960. I. ABCC TECHNICAL REPORT SERIES, II. PUBLICATIONS IN AMERICAN JOURNALS. III. PUBLICATIONS IN JAPANESE JOURNALS. (Atomic Bomb Casualty Commission, Hiroshima). 1960. 7p.

Sixty-eight references are included. (D.E.B.)

16782 (UR-588) STUDIES OF THE ACTION OF MERCURIC CHLORIDE ON INTESTINAL ABSORPTION. T. W. Clarkson and A. C. Cross (Rochester, N. Y. Univ. Atomic Energy Project). Feb. 10, 1961. Contract W-7401-eng-49. 68p.

When added to the solution bathing the mucosal surface of the isolated small intestine, the mercuric ion binds to the tissue by a first order reaction which is completed in approximately 30 minutes. The damage inflicted on the mucosal cells is closely dependent on the Hg dose. At doses below 0.2 μM/200 mg dry wt, the heavy metal produces an increase in the sodium permeability of the lumenal facing membrane of the mucosal cell. The uptake of glucose is inhibited. At doses above 0.2 μM/200 mg dry wt, Hg produces an abrupt and non-specific change in the permeability of the lumenal facing membrane allowing rapid loss of intracellular K and phosphate. These findings are discussed in relation to mercurialism in the whole animal. (auth)

16783 (JPRS-5498) CYTOLOGY. Translation of Tsitologiya, Volume II, No. 2, 1960. 339p.

This is a cover-to-cover translation of this journal. A separate abstract was prepared for one selected article. (C.H.)

16784 (JPRS-7884) CYTOLOGY. Translation of Tsitologiya, Volume II, No. 5, 1960. 196p.

This is a cover-to-cover-translation of this journal. Separate abstracts were prepared on two selected articles. (C.H.)

16785 (JPRS-7984) AGE CHANGES IN THE INTENSITY OF RADIOMETHIONINE INCORPORATION IN THE PROTEINS OF THE CRYSTALLINE LENS. E. (Ye.) V. Cherevychna and I. I. Chykalo. Translated from Ukrain. Biokhim. Zhur., 32: 678-81(1960). 7p.

Incorporation of S^{35}-labeled methionine into the proteins of the eye lens of rabbits declined with age. This was interpreted as indicating a gradual decrease in the biosynthesis of proteins. It is postulated that the marked reduction in biosynthesis of proteins may be one cause of the development of senile cataracts. (C.H.)

16786 ONTOGENY OF THE BLOOD CELLS. Royal F. Ruth (Carnegie Institution of Washington, Baltimore). Federation Proc., 19: 579-85(July 1960).

Results are reviewed from a series of morphological studies on the ontogeny of the blood cells. The evidence is interpreted as suggesting that the blood cells arise both from the endoderm and the mesoderm and that their difference in origin imparts differences in behavior and function. It is concluded that the endodermal hemopoietic organs produce antibody synthesizing cells, the bone marrow produces non-antibody producing cells, and the spleen produces both antibody producing and non-antibody producing cells. It is concluded that endodermal lymphocytes may migrate to other sites before or during the involution of the organs in which they first appear. The two types of lymphocytes thus have different prospective fates and normally react to some stimuli in different ways. These differences may be caused by their locations, inherent in their origins from different germ layers, or a result of location and inheritance. The plasma cells are considered of epidermal origin. (C.H.)

16787 COMPARISON BETWEEN LOCAL AND GENERAL REACTIONS IN VARIOUS TYPES OF RADIOTHERAPY AT HIGH ENERGY (Co^{60}, VAN DE GRAAFF AT 2 MEV, AND Cs^{137}). R. Miceli, C. Rimondi, and F. Bono (Università, Bologna). Radiobiol., radioterap. e fis. med., (3) 15: 421-36([1960]). (In Italian)

The local and general reactions observed during and after treatment with various types of radiation at high energy were analyzed and compared for single and fractionated doses. With respect to the cutaneous reaction, little difference was found between telecobalt therapy and Van de Graaff radiation, but cesium induced a reaction intermediate between the cobalt reaction and the x-ray therapy at 200 kv. The general reactions, especially the syndrome of radiation sickness and the effects of the hematic crasis, were shown very easily with the various types of radiation, although constantly less with the Van de Graaff in comparison with Co^{60}. (tr-auth)

16788 A METHOD AND PARAMETERS FOR THE ANALYSIS OF RENAL FUNCTION BY EXTERNAL SCINTILLATION DETECTOR TECHNIC. Richard L. Witcofski, Joseph E. Whitley, I. Meschan, and William E. Painter (Bowman Gray School of Medicine, [Winston Salem, N. C.] and North Carolina Baptist Hospital, Winston Salem, N. C.). Radiology, 76: 621-8(Apr. 1961).

A procedure for obtaining renograms is presented with acceleration of the vascular phase and determination of bladder and blood radioactivity at thirty minutes. A technic of analysis is proposed, disassociating the vascular phase and the secretory-excretory phase. This method is compared to others commonly employed. Parameters expressing the rates of secretion and excretion and total renal work are outlined. A method of performing clearance studies and its possible further applications are discussed. Normal values for the suggested parameters including acute clearance studies are presented for ortho-iodohippuric acid. This procedure affords a new approach to the estimation of renal blood flow. (auth)

16789 AGRICULTURAL RESEARCH. D. Roy Davies (Wantage Research Lab., Berks, Eng.) and R. Scott Russell. p.373-9 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Possible applications of Cs^{137}, or other long-lived γ sources separated from radioactive wastes, in plant breeding programs, and applications of other isotopes separated from waste products as radioactive tracers in fertilizer research are discussed. (C.H.)

Biochemistry, Nutrition, and Toxicology

16790 (UCRL-9419) A STUDY OF THE METABOLIC FATE OF THE RADIATION-PROTECTIVE COMPOUND, S,2-AMINOETHYLISOTHIURONIUM BROMIDE (AET), IN THE RAT (thesis). Frank Philip Conte (California. Univ., Berkeley). Oct. 10, 1960. Contract W-7405-eng-48. 77p.

The compound S,2-aminoethylisothiuronium bromide is representative of a class of radiation protective agents known as the aminoalkylisothiuronium salts. This study investigated the metabolic changes which this compound undergoes after its administration to a mammal using radioactively labeled AET. Measurements of the disappearance from the circulation of labeled AET, combined with tissue analysis, showed that there is a rapid distribution of radioactivity throughout most of the body tissues. Elimination studies show that the major route of excretion is the urinary system. The radioactivity found in the urine is in the main a mixture of chemical products. The data obtained by ion-exchange chromatography of urine indicated that approximately 18 to 19% of the injected dose of carbon-14-labeled AET appears as the following chemical structures: 2-mercaptoethylguanidine, guanidinoethyldisulfide, guanidinoethyldisulfoxide, and 2-guanidinoethylsulfonic acid. The radioactivity excreted in the urine following injection of S^{35}-labeled AET does not correspond to the pattern of products obtained with C^{14}-labeled AET. These data are interpreted as evidence that the sulfur atom of the injected thiol has exchanged with other compounds. (auth)

16791 (UR-589) THE EFFECTS OF PARATHYROID HORMONE ON PHOSPHATE TRANSPORT. W. F. Neuman and Carol Overslaugh (Rochester, N. Y. Univ. Atomic Energy Project). Feb. 13, 1961. Contract W-7401-eng-49. 13p.

Because of a developing interest in the effects of parathyroid hormone on phosphate transport, the gross tissue-uptake of radioactive phosphate was studied in young adult rats some of which were given crude parathyroid extract. Definitive changes caused by the hormone were observed in kidney and muscle. Despite the preliminary nature of these results, they are considered sufficiently encouraging to justify further investigation of hormone's action on phosphate transfer by cells. (auth)

16792 (UR-592) DISTRIBUTION AND EXCRETION OF THORIUM WITH EMPHASIS UPON ROUTE OF INJECTION AND AMOUNT OF CARRIER PRESENT. Robert G. Thomas (Rochester, N. Y. Univ.). Apr. 3, 1961. Contract W-7401-eng-49. 27p.

Four studies of the metabolism of thorium were reviewed and an attempt was made to establish qualitative differences in the distribution-excretion patterns as a function of the amount of thorium injected. After ingestion (gavage) thorium in either tracer or carrier amounts appears to be extremely insoluble and not appreciably (<0.5%) absorbed from the gastrointestinal tract. Of that material which is absorbed, most deposits in bone. Most thorium administered intravenously deposits in soft tissue, mainly organs of the reticuloendothelial system, from which it is slowly solubilized either going to bone or being excreted. The amount found in the skeleton following this route is largely localized in the marrow. Following injection to the muscle, lung, or other reservoir tissue, thorium behaves as a relatively insoluble material and enters the circulation very slowly as it is solubilized. The residence time in these reservoirs is extremely long, rendering the site of entrance to the body the choice for critical organ. A large fraction of thorium entering the circulation enters cancellous bone. (auth)

16793 DETERMINATION OF CHLORIDES IN PLASMA AND BLOOD BY THE RADIOMETRIC METHOD. A. A. Shatalova and G. I. Meerov (Bekhterev Scientific-Research Psychoneurological Inst., Leningrad). Biochemistry (U.S.S.R.) (English Translation), 25: 591-3(Mar.-Apr. 1961).

With the help of the isotope precipitation method, utilizing Ag^{110}, it is possible to conduct quantitative determinations of chlorides in blood and plasma. There is no necessity to know the specific activity of the precipitating reagent. (auth)

16794 DETERMINATION OF RADIOACTIVELY LABELED GLOBULIN TURNOVER BY THE DIRECT WHOLE-BODY COUNTING TECHNIQUE. Stuart W. Lippincott, Stanton H. Cohn, Helen Hamel, Samuel Fine, and Samuel Korman (Brookhaven National Lab., Upton, N. Y.). J. Clin. Invest. 40: 697-702(Apr. 1961). (BNL-4929)

The turnover rates of I^{131} labeled β and γ globulins in a hypergammaglobulinemic multiple myeloma patient were compared by the conventional serum and urinary excretion methods with those found using the in vivo whole-body gamma spectrometer counting method. The fractionated radioactively labeled globulins used in these studies were considered by free (Tiselius) electrophoresis and ultracentrifugal patterns to have an acceptable degree of homogeneity. The half-life for the β globulin was 9.9 days by the serum concentration method, 8.7 days by the urinary excretion method, and in two different studies by the in vivo whole-body counter method, 10.3 and 9.8 days, respectively. The half-life for the gamma globulin utilizing urinary data was 6.5 days as compared to 6.3 days for the whole-body counter method. By the latter technique, with a different gamma globulin preparation, the half-life was 7.1 days. (auth)

16795 INCORPORATION OF DIETARY RADIOCALCIUM INTO SKELETON OF RATS. John H. Weikel, Jr. and William F. Neuman (Univ. of Rochester, N. Y.). Metabolism, 10: 83-90(Jan. 1961)

A rather constant blood level of Ca^{45} was maintained by feeding both young and adult rats a diet of constant specific activity for a protracted period. The rate at which the isotope was incorporated into the skeleton was measured as a function of time on the diet. Accretion of new mineral was by far the most important way in which dietary calcium was incorporated into the skeleton. The rate of accretion varied in different parts of the skeleton; incisors and ribs had higher, molars somewhat lower, rates than average. Prolonged administration of parathyroid hormone to adult rats did not affect materially the level of skeletal radioactivity. This study demonstrates the possible pitfalls of using representative bone estimations and the difficulty of interpreting results of the single-dose type of experiment. (auth)

16796 THE ^{90}Sr CONTAMINATION OF MILK, CATTLE AND HUMAN BONES IN POLAND IN 1959. Julian Liniecki, Wanda Czsnowska, and Wieslawa Karniewicz (Inst. of Occupational Medicine Lódź, Poland). Nukleonika, 6: 57-64 (Jan. 1961). (In English)

The Sr^{90} content of cattle bones determined in Poland in 1959 varied between 1.3 and 45.9 $\mu\mu c/g$ Ca, the level of contamination being higher in animals living in highland region, in comparison to lowland ones. The level of contamination is decreasing with the age. The average concentration of Sr^{90} in milk was 7.2 $\mu\mu c/1$ g Ca. The concen-

tration of Sr^{90} in the anterior, almost purely spongy part of vertebra (vertebral body) amounted in 1959 in adults from Lódź to average of 0.8 ± 0.26 μμc/g Ca. The Sr^{90} content (per gram of calcium) of the remaining part of the vertebra is lower and the resulting weighted mean for whole bone is about 0.6 mμc/g Ca. The calculation of skeletal average concentration gives the result of nearly 0.3 μμc/g Ca. The concentration of Sr^{90} in children's bones was higher (measured in 7 samples from the age group 0 to 5 years) and amounted on the average to 1.7 μμc per gram of calcium.

Fallout and Ecology

16797 (TID-11783) SOME RESULTS OF STUDIES ON THE UPTAKE OF RADIOACTIVE WASTE MATERIALS BY MARINE AND ESTUARINE PHYTOPLANKTON ORGANISMS USING CONTINUOUS CULTURE TECHNIQUES. Technical Report XXI. W. R. Taylor (Johns Hopkins Univ., Baltimore. Chesapeake Bay Inst.). June 1960. Contract AT(30-1)-1477. 71p. (AD-243974)

Progress is reported in studies on the uptake of radioactive waste products by phytoplankton organisms in a marine environment. Laboratory studies were made of the growth requirements of a number of phytoplankton algae. Data are included on the uptake of Ru^{103} by a green algae and oysters and the uptake of Zn^{65} by selected marine algae. The advantages of the use of continuous culturing techniques for the study of the uptake of radioactive materials by phytoplankton organisms are discussed. (C.H.)

16798 CESIUM ABSORPTION OF THREE SPECIES OF FRESH-WATER PLANTS FROM SOLUTIONS OF DIFFERENT CONCENTRATION. A. A. Titlyanova and V. I. Ivanov. Doklady Akad. Nauk S.S.S.R., 136: 721-2 (Jan. 21, 1961). (In Russian)

Absorption by Elodea canadenesis Rich, Lemna minor L, and Ceratophyllum demersum L from various cesium solution concentrations from 10^{-9} to 10^{-3} g-eq/$_l$ is discussed. A graph of elodea and lemna absorption from various concentrations indicates a direct proportionality between cesium concentration in the solution and in the plant. The same was noticed with ceratophyllum. (R.V.J.)

16799 MOVEMENT OF RADIOACTIVE SUBSTANCES IN FOOD CHAINS. R. Scott Russell (Agricultural Research Council Radiobiological Lab., Letcombe Regis, Berks, Eng.). p.164-72 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

When fission products are deposited on the surface of the earth or on water they can be hazardous to man or to animals as sources of external radiation or by their accumulation within the organism itself. The passage of radioactive substances through food chains and factors affecting Sr^{90}/Ca relationships in the total diet are discussed. Procedures are described for mitigating the hazards due to the contamination of agricultural lands by fall-out fission products. (C.H.)

Radiation Effects on Living Tissues

16800 (ORO-378) THE GENETIC AND DEVELOPMENTAL EFFECTS OF INGESTED RADIOACTIVES IN HABROBRACON. Final Report. D. S. Grosch (North Carolina State Coll., Raleigh). [1960?]. Contract AT(40-1)-1314. 10p.

Data are summarized from a study on the genetic effects of ingested radioisotopes in the wasp Habrobracon. Results demonstrated the ovaries to be the weakest link in the insect life cycle following ingestion of P^{32} by adult females. Damage to the gonads was revealed by direct observation of whole mounts of ovarioles and by deverased egg production and lowered hatchability. The life span was also shortened by ingestion of radioisotopes. S^{35}, Ca^{45}, and Sr^{89} were also fed. Temporary and permanent infecundity and sterility were induced by Sr^{89}, but it was not as effective as P^{32}. The influence of the other two isotopes was seen only in reduced differentiation and hatchability of the most sensitive cell types. A descending order of effectiveness of the isotopes was shown to correspond to the ascending order of their physical half lives. Relatively brief biological half lives complicated the comparison of alkaline earth elements with other isotopes. A list is included of publications resulting from these studies. (C.H.)

16801 (TID-12603) THE INFLUENCE OF INTRANUCLEAR IRRADIATION ON THE GROWTH OF HeLa CELLS IN AGITATED FLUID MEDIUM. P. C. Sanders, D. F. Petersen, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.). [1960]. 18p.

Techniques are described which were developed to obtain quantitative data on the absolute uptake of thymidine and the influence of incorporated tritium β irradiation on cellular proliferation in agitated cultures maintained for relatively prolonged periods. Cultures of HeLa cells in agitated fluid medium were coupled with multichannel electronic particle counting and quantitative beta counting procedures. Results indicate that essentially comparable amounts of energy deposited per nucleus by decay of tritiated thymidine and tritium water exert markedly different biological effects. Possible mechanisms are discussed. (C.H.)

16802 (TID-12606) STUDY OF THE ACTION OF RADIATION ON DEOXYPENTOSE NUCLEIC ACIDS HAVING BIOLOGICAL (TRANSFORMING) ACTIVITY. Final Report, June 1, 1956–June 1, 1961. Stephen Zamenhof (Columbia Univ., New York). Contract AT(30-1)-1928. 10p.

Results are reported from studies on the resistance of the transforming activity of desoxyribonucleic acid to various doses of ultraviolet radiation. Differential stabilities were demonstrated for individual heredity determinants in the same preparation of transforming principle from H. influenzae. Results are also included from a study on the effects of ultraviolet radiation on the survival of bacterial cells having unnatural pyrimidine in their desoxyribonucleic acid. (C.H.)

16803 (UR-587) THE PHARMACODYNAMICS OF MULTIPLE INHALATION OF POLONIUM^{210} IN THE RAT. Harry L. Berke and Alfred C. DiPasqua (Rochester, N. Y. Univ. Atomic Energy Project). Feb. 7, 1961. Contract W-7405-eng-49. 53p.

A group of Wistar strain rats were repetitively exposed to a salt aerosol containing small amounts of Po^{210}. Tissue distributions and excretion of the radionuclide were determined and compared with those following a single inhalant exposure. The excretory rate following multiple inhalation appears to be 2 to 3 times more rapid than that following a single exposure. Accumulatory rates of organ activity are fairly similar with each exposure regimen but the amount of activity in the organs is larger relative to the post-exposure body burden following the repetitive inhalation. The advantages of a multiple inhalant exposure for determining some of the parameters useful in assessing radiological injury are indicated. (auth)

16804 (UR-591) EFFECTS OF PROTEIN DEPLETION ON THE LETHALITY OF WHOLE OR PARTIAL BODY X-IRRADIATION OF THE RAT. Arland L. Carsten and Thomas R. Noonan (Rochester, N. Y. Univ.). Feb. 24, 1961. Contract W-7401-eng-49. 9p.

Rats maintained on a protein-free diet for several weeks prior to and continued on this diet after whole-body, upper-body, or lower-body x-irradiation showed increased susceptibility to the first two types of exposure but no difference in susceptibility to lower body x-irradiation. (auth)

16805 (USNRDL-TR-503) LATENT RADIATION-INDUCED INHIBITION AND RECOVERY OF MITOTIC ACTIVITY IN MOUSE KIDNEY. L. J. Cole and V. J. Rosen (Naval Radiological Defense Lab., San Francisco). Apr. 7, 1961. 16p.

Young adult hybrid mice were given an LD_{100} dose of 250 kvp x rays in a single whole-body exposure. This was followed within a few hours by an injection of bone marrow cells (approx. 5×10^6 nucleated cells) derived from normal mice of the same strain. Groups of these mice were then subjected to unilateral nephrectomy at 2, 4, and 9 weeks post-irradiation. The remaining kidney was extirpated 48 hours post-nephrectomy, and the mitotic activity determined on stained kidney sections. Mitotic activity was expressed as number of mitoses per 50 high-power fields (approx. 400 cells per high power field). It was found that the radiation exposure elicited a latent injury in the kidney cells, which was expressed as an incapacity to initiate cell division following a stimulus to mitosis applied 2 weeks after irradiation. Recovery from this latent damage was evident by 4 weeks post-irradiation, when the mitotic activity values approached those observed in non-irradiated controls subjected to unilateral nephrectomy (i.e., 136 and 147 mitoses per 50 fields). At 9 weeks post-irradiation there was an "overshoot" in mitotic activity (as high as 221 mitoses per 50 fields) as compared with the non-irradiated controls. (auth)

16806 (AEC-tr-4533) THE GENETIC DANGER OF SMALL RADIATION DOSES FOR MAN AND THEIR EFFECT ON THE HEREDITY OF MONKEYS AND RODENTS. N. P. Dubinin, M. A. Arsen'eva (Arsen'yeva), and Yu. Ya. Kerkis (Akademiya Nauk S.S.S.R.). 1960. Translated from United Nations Report A/AC.82/G/L.406. 20p.

Results are reviewed from a number of studies on the genetic effects of radiation in mammals. Data are summarized from a comparative study of the radiosensitivity of the monkey, Macaca mulatta, and mice in the dose range 10 to 600 r. A study was made of the rate of chromosome rearrangements and histological characteristics of the testes of monkeys and mice following irradiation. Results indicate that the radiosensitivity of monkeys is two to three times greater than that of mice. Results are also reported from studies on the effects of doses of 5, 7, 10, 25, and 50 r of x radiation on the rate of chromosome rearrangement in human embryonic cells in tissue culture. It was calculated that a radiation dose of 10 r doubles the mutation rate in man. The increased genetic effects of fast neutrons in comparison with the effects of x or γ radiation are discussed. The gentic hazards of radioactive fall-out resulting from the detonation of atomic and thermonuclear devices for man are estimated, and it is concluded that continuation from nuclear detonations is inadmissible from the standpoint of radiation genetics. (C.H.)

16807 (JPRS-5498(p.127-36)) THE INFLUENCE OF THE STATE OF PLANT CELLS ON THEIR RADIOSENSITIVITY TO γ-IRRADIATION. T. G. Mamedov. Translated from Tsitologiya, 2: No. 2, 1960.

A study was made of the change in radiosensitivity of meristem cells of roots of Vicia faba grown from seeds which were in different functional conditions at the time of irradiation, as well as of the dynamics of growth of the rootlets after irradiation. It was found that the radiosensitivity of soaked seeds is approximately 4.5 times as great as that of dry seeds; just sprouted seeds, 15 times as great; three-day sprouts, 42 times, and seven-day sprouts, 32 times as great as that of dry seeds. It was found that recovery of the rate of growth of roots which have been decreased as a result of irradiation with low doses (60, 90, 150 r) occurs on the fifth to seventh day after irradiation, and with higher doses (270 r) it is absent. (auth)

16808 (JPRS-7865) STATE OF THE HEMATO-ENCEPHALIC BARRIER IN THE PROGENY OF ANIMALS IRRADIATED WITH GAMMA-RAYS. V. A. Tats'evskii (Tatsiyevskiy). Translated from Patol. Fiziol. i Eksptl'. Terap., 4: No. 6, 66-7(Nov.-Dec. 1960). 3p.

P^{32} was used as a tracer in studies on the permeability of the hemato-encephalic barrier in the progeny of irradiated guinea pigs. Permeability was lower in the 3rd generation progeny than in the controls. Permeability was not uniform in the various cerebral areas, and varied in individual guinea pigs. (C.H.)

16809 (JPRS-7884(p.39-51)) COMPARATIVE INVESTIGATION OF LIVING AND FIXED CELLS OF THE BONE MARROW OF IRRADIATED ANIMALS BY THE METHOD OF ULTRAVIOLET MICROSCOPY. M. P. Bukhman and T. M. Kondrat'eva (Kondrat'yeva). Translated from Tsitologiya, 2: No. 5, 1960.

The effect of ionizing radiation on living bone marrow cells of animals is manifested in a shift in the uv absorption, chiefly by cytoplasm, toward the long waves. In cells in bone marrow smears of irradiated animals fixed with formalin vapors a large number of clear nuclei appear which do not absorb uv well at a wavelength of 254 to 280 mμ. In the bone marrow of non-irradiated animals fixed with formalin vapors cells are found with clear nuclei but in small numbers. In living cells or cells in unfixed smears of bone marrow of irradiated animals the clear nuclei are not found either visually or photographically. The appearance of cells with clear nuclei in much larger numbers in the bone marrow cells of irradiated animals can be explained by the fact that the injurious effect of fixation is more severely manifested in cells which have been first altered by ionizing radiation. (auth)

16810 (JPRS-7884(p.114-26)) THE RELATIVE EFFECT OF PRIMARY RADIATION INJURIES TO THE NUCLEUS AND CYTOPLASM OF SEX CELLS OF THE SILKWORM. V. A. Strunnikov. Translated from Tsitologiya, 2: No. 5, 1960.

Results are reported from four studies of the relative effect of primary radiation injuries to the nucleus and cytoplasm of sex cells of the silk worm by means of the method of experimental androgenesis. Female moths which had not been inseminated were irradiated with x and γ rays in doses of 20 to 1100 kr, after which they were paired with non-irradiated males. One part of the eggs of each variant deposited was not irradiated, and the other was subjected to a thermal effect with the aim of induction of androgenesis. Without heating, the zygotically developing eggs of the control series died after all doses of irradiation, as a result of the participation of an irradiated female nucleus in the development. By heating the eggs obtained from fertilization, the irradiated female nucleus was eliminated, and the development of the egg was changed over to an androgenetic route with the participation of a diploid segmentation

nucleus formed by the coalescence of two non-irradiated male nuclei. In androgenetically developing eggs, therefore, an irradiated cytoplasm of the egg was combined with non-irradiated nuclear material of paternal origin. Because differences between the variants of each experiment consisted only of irradiation doses to the cytoplasm the marked reduction in the yield of androgenetic caterpillars recorded in all experiments after irradiation with doses exceeding 60 to 90 kr and the death of the eggs with the highest doses of irradiation constitute proofs of the presence of primary radiation injuries to the cytoplasm. In two experiments it was noted that scattered androgenetic caterpillars came from eggs the cytoplasm of which had been irradiated with a dose of 500 kr. This dose is approximately 20 to 25 times greater than the dose which causes the death of zygotically developing eggs which had obtained an irradiated nucleus and cytoplasm from the mother and non-irradiated nucleus from the father. Irradiation of the cytoplasm with doses of 20 to 54 kr did not lead to sterility or reduction in the viability of androgenetic individuals. (auth)

16811 (JPRS-7931) CULTIVATION IN VITRO OF THE BONE MARROW AND SPLEEN OF RABBITS IRRADIATED WITH X-RAYS. V. A. Gubin. Translated from Arkh. Anat. Gistol. i Embriol., 39: No. 11, 3-10(Nov. 1960). 11p.

The effects of whole-body exposure to doses of 350, 700, and 1400 r of x radiation on the hematopoietic system of rabbits were studied in tissue cultures of spleen and bone marrow taken 1 to 2 hr, and 1, 3, 5, 10, 20, and 30 days after exposure. Histologic sections were made daily throughout a 30-day period. Three basic phases of cellular change observed are described. Lymphocytes were observed to be the most radiosensitive cells and mature neutrophiles the most radioresistant. The injurious effects of radiation on blood cells were less pronounced when the tissue cultures were taken during the first few hours after exposure. (C.H.)

16812 (JPRS-7932) POSTTRAUMATIC REGENERATION OF SKELETAL MUSCULATURE UNDER TOTAL AND LOCAL IRRADIATION WITH X-RAYS. E. (Ye.) V. Dmitriyeva. Translated from Arkh. Anat. Gistol. i Embriol., 39: No. 11, 11-22(Nov. 1960). 19p.

Results are reported from a comparative study of the effects of acute radiation sickness and local irradiation on the regeneration of skeletal muscles after trauma. The experiments were made on rats. Reaction mechanisms were found to differ. Histological observations are summarized. (C.H.)

16813 (JPRS-7933) REGENERATION OF STRIATED MUSCLE AFTER X-RAY IRRADIATION. Wang-Hsiu Pi. Translated from Arkh. Anat. Gistol. i Embriol., 39: No. 11, 23-32(Nov. 1960). 15p.

Exposure of the legs of rats, regenerating from traumatic injury, to local doses of 2000 r of x radiation resulted in a reduction in muscular response to stimuli. The weight of the muscle and mitotic division in connective tissue cells were also reduced by irradiation. Histologic examination showed the traumatic region was filled primarily with loose connective tissue. (C.H.)

16814 (JPRS-7955) DEGENERATIVE AND REPARATIVE PROCESSES IN THE CEREBRUM FOLLOWING RADIATION INJURY. A. A. Manina. Translated from Arkh. Anat. Gistol. i Embriol., 39: No. 11, 33-42(Nov. 1960). 17p.

Results are reported from a study of histological changes induced by doses of x radiation ranging from 10 to 400 r in the developing brains of rat embryos and new-born rats. The most marked disturbances were produced in 18- and 19-day embryos. Radiation injuries depended on the dose of radiation and the stage of development of the nerve elements of the brain. (C.H.)

16815 (JPRS-7958) HEALING OF COMMINUTED FRACTURES FOLLOWING THE ADMINISTRATION OF DIFFERENT DOSES OF RADIOACTIVE PHOSPHORUS. G. N. Ushakova. Translated from Arkh. Anat., Gistol. i Embriol., 39: No. 11, 60-7(Nov. 1960). 12p.

The effects of various subcutaneous doses of P^{32} on the healing of bone fractures was studied in 151 rabbits. The P^{32} was given on the second or third day after trauma and was repeated at intervals. The processes of healing were checked with x-ray films and by histologic studies at various times from 3 to 30 days after trauma. The distribution of P^{32} in damaged and healthy bone was studied by means of radioautograms. Data are summarized. On the basis of the observations, it was concluded that the administration of small doses of P^{32} did not stimulate the healing of bone fractures, and large doses caused no detectable impairment of the healing process. (C.H.)

16816 (JPRS-7974) ON REDUCTION OF THE DIGITS IN MOUSE EMBRYOS FOLLOWING X-RAY IRRADIATION. A. A. Neyfakh. Translated from Arkh. Anat. Gistol. i Embriol., 39: No. 11, 74-82(Nov. 1960). 14p.

Variations in the number and development of digits were observed in mouse embryos exposed on the 10th to 12th day of intrauterine life to a dose of 300 r of x radiation. Variations included reductions of 1 to 4 digits and increases of 1 or 2 digits. Reductions of 3 or 4 digits of the forelimbs resulted only from irradiation on the 11th day and reductions of digits of the hindlimb resulted only from irradiation on the 11th and 12th day. It was concluded that there is a specific period of highest sensitivity for each type of reduction. (C.H.)

16817 (JPRS-7983) EFFECT OF RADIANT ENERGY ON CHANGES IN THE ALDOLASE ACTIVITY AND THE SH GROUPS OF MYOGEN A. M. A. Kolomiychenko and I. P. Stasevs'ka. Translated from Ukrain. Biokhim. Zhur., 32: 645-52(1960). 10p.

Exposure of solutions of myogen A to doses of 100,000 r of x radiation or doses of 7.0 watt-sec/cm^2 of ultraviolet or infrared radiation resulted in inactivation of aldolase activity and oxidation of the sulfhydryl group. The degree of inactivation and the degree of oxidation of sulfhydryl groups depended on the energies of the photons. Reaction mechanisms involved in inactivation and photoreactivation of myogen A are discussed. (C.H.)

16818 (NP-tr-579) DATA ON ORNITHOSIC INFECTION IN THE IRRADIATED AND NON-IRRADIATED WHITE RAT. I. Berlogea, I. Strati, and S. Schoenfedl. Translated from Acad. rep. populare Romine Inst. inframicrobiol., Studii cercetari inframicrobiol. microbiol. parazitol., 11: 111-15(1960). 6p.

Whole-body exposure of rats to 510 r of x radiation did not reduce natural resistance to ornithosic virus. Irradiation reduced the titer of compliment-fixation antibodies by half. (C.H.)

16819 (NP-tr-599) THE DIGESTION BY PEPSIN OF SERUM PROTEIN IRRADIATED WITH GAMMS RAYS. Ya. A. Epshtein and E. A. Zabozlaeva. Translated by A. Schoenfeld (U.K.A.E.A. Atomic Energy Research Establishment) from Biokhimiya, 20: 701-4(1955). 10p.

The irradiation of serum protein by γ rays accelerates its digestion by pepsin. Products of protein decompostion are formed rapidly which are not adsorbed by the strongly basical anionite. During the peptolysis of irradiated protein decomposition products are formed which are adsorbed by this anionite. The acceleration of the peptolysis of the serum albumen depends upon the intensity and duration of the irradiation and is connected with the denaturation of the protein molecule. (auth)

16820 SOME EFFECTS OF X-IRRADIATION ON THE DEVELOPMENT OF CORPORA LUTEA IN THE ALBINO RAT. Thomas Ellis Malone (Argonne National Lab., Ill.) Am. J. Anat., 107: No. 2, 177-92(Sept. 1960).

The effects of radiation on the development of the corpus luteum were studied in sexually mature, cyclic virgin female rats. The animals were subjected to dosages of x radiation ranging from 400 r to 4800 r, administered to the dorsolumbar region at a time corresponding roughly to the immediate preovulatory period. Sequential events in control and experimental ovaries were then followed through 8 sacrifice periods covering a complete developmental cycle. (auth)

16821 BOUND AND SOLUBLE DEOXYPOLYNUCLEOTIDES IN THE TISSUES OF IRRADIATED RABBITS. T. N. Rysina and R. E. Libinzon. Biochemistry (U.S.S.R.) (English Translation), 25: 639-42(Mar.-Apr. 1961).

The content of protein-bound DNA and of soluble desoxypolynucleotides was studied in the lymphoid tissue of the appendix, in the spleen, bone marrow, small intestinal mucosa, liver, and blood of rabbits. The highest concentration of bound DNA was found in metabolically active tissues. Irradiation of rabbits with the dose of 1000 r resulted in a decrease in the protein-bound DNA by 60 to 40% in the bone marrow, spleen, and the appendix; in the small intestinal mucosa, the decrease was 20%. The quantity of free DNA in these tissues increased considerably and reached a maximum in four hours. In the liver and blood, no significant changes in the content of free and protein-bound DNA were found. (auth)

16822 THE EFFECT OF X-RAY IRRADIATION ON THE STRUCTURAL VISCOSITY OF RAT LIVER DEOXYRIBONUCLEIC ACID IN ONTOGENESIS. I. I. Ivanov, N. N. Aksenova (Khor'kova), and L. V. Suvorova (Pediatric Medical Inst., Leningrad). Biochemistry (U.S.S.R.) (English Translation), 25: 668-73 (Mar.-Apr. 1961).

The structural viscosity of DNA from the liver of rat embryos, newborn, and adults was measured after irradiation with x rays in doses of 1000 and 2000 r. After irradiation of the embryos and newborn rats in doses of 1000 r and after 24 hours, the mitotic activity of the liver cells fell to 0 in the embryos and by 50% in the newborn; nevertheless, the structural viscosity of the DNA isolated from the livers was practically unchanged. The characteristic viscosity of liver DNA from newborn rats before and after irradiation of the animals with x rays in doses of 1000 r was practically unchanged, which indicates the absence of change in molecular weight of the DNA under these conditions. (auth)

16823 BLOOD GROUP ANTIBODY LEVELS IN HIROSHIMA. James W. Hollingsworth, Howard B. Hamilton, Gilbert W. Beebe, and Mitsuru Yamasaki (Atomic Bomb Casualty Commission, Hiroshima-Nagasaki, Japan). Blood, 17: 462-73(Apr. 1961).

Blood group antibody levels were measured in 526 irradiated survivors of the 1945 atomic bombing of Hiroshima and in 516 nonirradiated subjects. The study was undertaken in order to determine the age changes in antibody levels in irradiated and nonirradiated subjects, as well as to investigate the pattern of blood agglutinin levels in the Japanese population for comparison with that of Caucasians. Peak antibody titers were reached at age 20 to 30, with progressive linear regression in levels with advancing age. Peak titers in early adulthood were 5 to 10 times higher than those of the very elderly. No correlation between blood group antibody levels and atomic irradiation was detected, whether irradiation was represented by presence or absence of acute radiation symptoms in 1945, distance from the hypocenter, or numerical dosage estimate. (C.H.)

16824 THE SENSITIVITY OF SEXUAL EPISOMES AND COLICINOGENESIS OF ESCHERICHIA COLI K 12 TO THE DISINTEGRATION OF RADIOPHOSPHORUS. Robert Lavallé and François Jacob (Institut Pasteur, Paris). Compt. rend., 252: 1678-80(Mar. 13, 1961). (In French)

Escherichia coli K 12 F^+ labeled with radiophosphorus are crossed with nonradioactive F^- receptor bacteria. The F^+ character thus transferred is inactivated by the P^{32} disintegration without affecting the survival of the receptor bacteria. On the contrary, there is none or little inactivation of the colicinogenetic determinant in experiments of the same type. (tr-auth)

16825 EFFECTIVENESS OF SELECTION FOR QUANTITATIVE CHARACTERS IN THE THIRD GENERATION FOLLOWING IRRADIATION OF SOYBEAN SEEDS WITH X RAYS AND THERMAL NEUTRONS. Kenneth E. Papa, J. H. Williams, and D. G. Hanway (Nebraska Agricultural Experiment Station, Lincoln). Crop Sci., 1: 87-90(Mar.-Apr. 1961).

The third generation of two soybean populations following irradiations of seed with x rays and thermal neutrons was sampled to determine the effectiveness of selection for the quantitative characters of yield, maturity, seed weight, oil content, and protein content. Generally, more variation existed in the irradiated than in the nonirradiated populations for most of the characters studied. Selection for high yield was effective in both the irradiated and nonirradiated Hawkeye populations but was ineffective in the Adams variety. Although a selection advantage existed for yield in the irradiated populations, the amount of gain was hardly enough to compensate for the lower initial yield of the irradiated as compared to the nonirradiated populations. Several high yielding progenies were observed that possessed additional desirable qualities. For the more highly heritable characters, maturity, seed weight, oil content, and protein contents, selection was generally more effective in the irradiated than in the nonirradiated populations. Significant gains from selection were made in nearly all of the irradiated populations. Comparisons of observed and predicted gains from selection were made. Fairly good agreement was obtained between observed and predicted values for the irradiated populations in the Hawkeye yield test. For the other characters studied, significant gains from selection were made however, they were considerably less than the predictions. (auth)

16826 INDUCED MUTATION RATES WITH GAMMA RAYS AT A SPECIFIC LOCUS IN OATS. A. T. Wallace and H. H. Luke (Florida Agricultural Experiment Station and Crops Research Div., ARS, USDA, Gainesville, Fla.). Crop Sci., 1: 93-6(Mar.-Apr. 1961).

Seeds of the Victorgain variety of oats, which are susceptible to the fungus Helminthosporium victoriae, were irradiated with Co^{60} γ rays and grown to maturity in isolation. The germinating seeds in the X_2 generation were

treated with toxin produced by the fungus H. victoriae, and resistant seedlings were selected. These resistant seedlings represent induced mutations at the locus controlling susceptibility in the oat variety. When the seeds at 10% moisture were irradiated at 0, 9, 18, 27, and 36 kr at an intensity of 4.5 kr per minute, the induced mutation rates were 0, 10.4, 13.6, 0.9, and 5.1×10^{-8} per roentgen per locus, respectively. When the seed moisture was 33%, obtained by hydration at 2°C, and irradiation was applied at 0, 4.5, 9, and 13.5 kr at an intensity of 4.5 kr per minute, the induced mutation rates were 0, 35.9, 10.9, and 1.5×10^{-8}/r/locus, respectively. When the seeds with moisture of 10% were given doses of 17 kr and 25 kr at low intensities the induced mutation rates were 8.8 and 4.6×10^{-8}/r/locus, respectively. These induced mutation rates are in the same order of magnitude as those reported for mice and Drosophila, did not increase linearly with increasing dosage, were influenced by moisture content of the seeds at the time of irradiation, and were not influenced by the range in intensity tested (20 r/minute to 4.5 kr/minute). (auth)

16827 MORPHOLOGICAL AND CYTOLOGICAL CHANGES IN CENTURY PATNA 231 AND BLUEBONNET 50 RICE RESULTING FROM X-RAY AND THERMAL NEUTRON IRRADIATION. Hasanuzzaman Muhammad Shah, H. M. Beachell, and I. M. Atkins (Texas Agricultural Experiment Station, College Station and Texas A. and M. Coll., Beaumont). Crop Sci., 1: 97-102(Mar.-Apr. 1961).

Morphological and cytological studies of one X_2 (maintained vegetatively) and 20 X_5 lines of Bluebonnet 50 and Century Patna 231 rice varieties obtained from seeds exposed to different dosages of x rays and thermal neutrons revealed a number of interesting and valuable mutant types. These included mutations of leaf size and color, growth habit, plant height and straw strength, panicles, spikelets, flowering habit, and fertility. Some of the short-stature and other plants may have considerable economic value in breeding lodging resistant varieties. Cytological studies revealed that one plant was a tetraploid. Most plants studied were diploid but often had abnormal chromosome numbers or association. Univalents, trivalents, and quadrivalents were common but fragments, asynapsis, knot formations, irregular division, bridge formations, and differences in pollen grain size were observed. There was a positive correlation between quadrivalents in P.M.C. and pollen sterility and between pollen and spikelet sterility, although there were some unusual exceptions to this. (auth)

16828 GENETIC VARIABILITY IN OATS FOLLOWING HYBRIDIZATION AND IRRADIATION. Charles F. Krull and Kenneth J. Frey (Iowa Agricultural and Home Economics Experiment Station, Ames). Crop Sci., 1: 141-6(Mar.-Apr. 1961).

The effects of an acute dose of thermal neutron irradiation on the genetic variability of 3 quantitatively inherited characters, heading date, height, and 100-seed weights, in pure line and hybrid populations of oats were evaluated. Plants from irradiated lots of 1000 seeds of both Clintland and Beedee and 2000 F_2 seeds of Clintland × Beedee and nonirradiated lots of 200 Clintland, 200 Beedee, and 2000 F_2 seeds were grown to maturity in the greenhouse. This was a precautionary measure to minimize the natural crossing that occurs in irradiated field populations. A space-plant row from each greenhouse plant was grown in the field in 1958, and data were recorded for heading date, height, and chlorophyll and fatuoid mutants. Individual plants from each row were harvested and threshed, and 100-seed weights were determined on a portion of the plants. For one experiment in 1959, two plants were chosen at random to represent each family (row), and for the second experiment the plants having the highest and lowest seed weights within a family were selected. The experiments, each containing 1008 entries representing 504 families, were replicated 4 times in hill plots. Variance analyses of the 1959 data indicated that radiation increased the variance both between and within families in Clintland, Beedee, and hybrid backgrounds. No consistent positive or negative shifts in skewness values were induced by radiation which suggests that equal numbers of beneficial and detrimental mutations were caused. The increased variance due to radiation showed that lines were shifted from the central portion of the distributions, and consistent positive kurtosis values for all three characters indicated that the extremes of the curves were increased relatively more than the flanks. Both the results from the selection experiment and the heritability percentages indicated that the variability created by radiation was equally as heritable as that due to hybridization. (auth)

16829 THE CYTOGENETIC AND PHYSIOLOGIC EFFECT OF ETHYLENEMINE AND γ-RAYS ON THE SEEDS OF WHEAT. N. N. Zo (Inst. of Biological Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 712-13(Jan. 21, 1961). (In Russian)

Physiological and cytogenetic effects of ethylenimine on soft summer wheat seed were compared with the effects of γ rays. The character of chromosome structure in mutants and its influence on seed germination and early sprout growth were studied. The tests were made with aqueous ethylenimine solutions of 0.01, 0.06, 0.08, 0.1, 0.12, 0.15, 0.2, and 0.3%; the γ rays were given in 2.5, 5.0, and 10 kr doses. Ethylenimine concentrations of 0.01% slowed sprout growth without influencing germination, with 0.08% concentrations nearly 70% of the sprouts broke through the coleoptile and continued to grow at a rate slightly below controls. At 0.2 to 0.3% concentrations, only separate seeds germinated. Gamma doses of 2.5 and 5.0 kr did not alter growth or germination. At 10 kr all the seeds germinated but the sprouts grew slower than controls. Further cytological studies were made with roots fixed 72 hours following wetting in ethylenimine and γ irradiation in water. The results indicate different fragmentations and breakages. The difference may be related to the long-range effects of ethylenimine and the short term effects of γ rays acting at different stages in cell division. (R.V.J.)

16830 A CONTRIBUTION TO MUTATION THEORY. M. V. Vol'kenshtein and A. M. El'yashevich. Doklady Akad. Nauk S.S.S.R., 136: 1216-18(Feb. 11, 1961). (In Russian)

The probability for the occurrence of mutations is assumed to be due to the formation of various types of loops in the nucleotides of desoxyribonucleic acid (DNA). The probability of a mutation (formation of a loop) in a given link containing the base K (adenine, cytosine, guanine or thymine) is determined by the expression $W = \exp(-\Delta F_K/kT)$, where ΔF_K is the difference in free energies between mutated and unmutated states of the link containing the base K in the DNA chain. The calculated probabilities for the formation of various types of loops vary from 3×10^{-3} to 4×10^{-8}. The experimental value based on 10^{-5} mutations per gene per generation gives an average probability of a point mutation at a given link of the DNA chain of the order of 10^{-10}. The actual number of mutations may be much larger than 10^{-10}, since only a fraction of the muta-

tions leads to observable changes. The discrepancy between the calculated and experimental values may be due to kinetic factors, or to the necessity for the formation of a succession of loops in order to observe a mutation. The high local temperature caused by radiation or a disturbance in the relative concentrations of various nucleotides in the cytoplasm because of radiation can affect the calculated probability values. Hence, it is concluded that a mutation model based on "loops" is promising in explaining experimental results. (TTT)

16831 ON THE POSSIBILITY OF DECREASING THE VALUE OF IONIZATION FLUCTUATIONS IN GASES. A. A. Vorob'ev, A. P. Komar, and V. A. Korolev (Physics and Technical Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 54-7(Mar. 1, 1961). (In Russian)

Farro found that $\delta_N^2 = \overline{(N-N_0)^2}/N_0^2 = F/N_0$, where δ_N is the fluctuation in the number of ion pairs formed by an average number of ion pairs N_0. The value of F was found to be 0.22 in argon gas. It can be shown that the fluctuation in the total number of ionized and excited molecules is much smaller. Hence, addition of a small amount of suitable impurity gas which can transform excited states to ionized states will result in a significant increase in resolving power of an alpha spectrometer. Limiting values of F for He, Ne, Ar, Kr and Xe were found to be 0.0038, 0.0083, 0.012, 0.014 and 0.016 respectively, while values of F from Farro's formula varied from 0.33 to 0.38. Thus, there is reason to believe that the limiting half-width of an alpha line can be lowered to 4 kev from 14 kev with the addition of a supplementary ionizing gas. (TTT).

16832 EYE DESTRUCTION RESULTING FROM INTRAOCULAR OPERATIONS PRACTICED FOLLOWING A CONSIDERABLE DOSE OF IONIZING RADIATION. V. V. Popov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 137: 192-5(Mar. 1, 1961). (In Russian)

It had been previously observed that if the crystalline lens is removed from amphibians and then reinserted in the eye at 180° in a front to back direction from its former position, the lens would slowly rotate back to its former position within a period of 4 to 8 days. This operation was performed on tadpoles (Rana temporaria) 2 to 3 days after irradiation with doses of 20, 100, 200, 500 and 1500 r., and it was noticed that inversion of the crystalline lens did not take place at a dose of 500 r and greater. The left eye of the irradiated tadpoles, which was used as a control, showed no apparent changes even though the tadpole was irradiated with a 1500 r dose, while the right eye which had been inverted showed signs of intensive destruction. The data indicate that surgical intervention on the eye could be very harmful to vertebrates and man when superimposed on a background of a large dose of ionizing radiation. (TTT).

16833 THE REPRODUCTION OF BACTERIOPHAGE IN IRRADIATED NON-VIABLE (NON-FISSIONING) CELLS. G. E. Fradkin. Doklady Akad. Nauk S.S.S.R., 137: 196-8 (Mar. 1, 1961). (In Russian)

The ability of irradiated bacteria to reproduce bacteriophage serves as a measure of radiation damage to fermentative cell systems. The colibacteriophages of the even group T-2 or T-4 were used in this study rather than those of the odd group T-3, because the DNA content of the even bacteriophages is different in composition from the DNA content of the bacteria. A suspension of bacteria (E. coli "B") was irradiated in a synthetic medium proposed by Adams with lethal doses of 5.0×10^4 and 7.5×10^4 r during the logarithmic stage of growth. The irradiated suspension was diluted to reduce the number of fissioning cells to a minimum which were determined by growth on a Petri dish in 2% agar. A definite amount of intact bacteriophage T-4 was added to the control and irradiated solutions, and the number of bacteriophage particles was determined by the agar layer method of Gratsii. The results show that bacteria lose their ability to fission after irradiation with large doses, but retain their ability to reproduce bacteriophage. The ability of irradiated bacteria to reproduce bacteriophage after having lost their ability to fission is proof of the radio-resistance of ferment systems. (TTT).

16834 STUDIES ON MICROORGANISMS. Alexander Hollaender (Oak Ridge National Lab., Tenn.). Federation Proc., 19: 562-3(July 1960).

A brief survey is presented of studies on reaction mechanisms involved in radiation protection and recovery of microorganisms from the effects of ionizing radiations. The influence of oxygen, nutritional state, enzyme systems; pH of the growth medium, cysteamine treatment, streptomycin treatment, radiation energy, and radiation dose on radiosensitivity is discussed. Data are tabulated on the effect of growth and plating medium on the survival of E. coli exposed to 20000 r x radiation. (C.H.)

16835 OSTEOLYSIS FOLLOWING RADIATION INDUCED FRACTURE OF THE CLAVICLE. J. Kolar (Charles Univ., Prague). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed, 94: 486-9(Apr. 1961). (In German)

A case is described in which osteolysis of the lateral half of the clavicle was observed following a radiation induced fracture. No previous observation of a similar complication following irradiation of bone has been described. The phenomenon may be compared with the spontaneous absorption of bone following fractures in this region. (auth)

16836 INCREASED RECOMBINATION FROM FEMALE DROSOPHILA IRRADIATED AS LARVAE WITHOUT OÖCYTES. Maurice Whittinghill and David Gale Davis (Univ. of North Carolina, Chapel Hill). Genetics, 46: 357-60(Apr. 1961).

Different x-ray doses to late third instar larvae of Drosophila produced elevated frequencies of crossovers only from eggs laid in the first week of the imagoes. Three broods from 8 to 21 day-old adults were homogeneous among control and three irradiation dosage groups. Comparison of noncrossover and crossover frequencies showed no evidence of radioresistant cells among the oögonia present in x-rayed larvae. Higher crossover and lower noncrossover values were found in the 14 to 21 day brood rather than in the earliest brood of the controls. This response of Drosophila and the lack of such response of Habrobracon to irradiation are discussed. (auth)

16837 PHOTOPROTECTION AGAINST X-RAY INACTIVATION IN NOCARDIA CORALLINA. J. B. Clark and Janice Frady (Univ. of Oklahoma, Norman). J. Bacteriol., 81: 524-6(Apr. 1961).

Visible light irradiation of Nocardia corallina was found to render the culture more resistant to subsequent x irradiation. The dose rate of x irradiation was found to be significant in displaying this effect. If the x irradiation was delayed for more than 5 hr after the visible light irradiation, the resistance was lost. This rapid decay eliminated the possibility of the results being due to a selective action for normally occurring resistant cells, since revision to the resistance of the parent culture has been found to occur at a much slower rate. The results appear to be attributable only to a photoprotective action. (auth)

16838 THE EFFECTS OF TOTAL BODY IRRADIATION ON SOME ASPECTS OF HUMAN IRON METABOLISM. Jack Levin, J. Robert Andrews, and Nathaniel I. Berlin (National Cancer Inst., Bethesda, Md.). J. Clin. Invest., 40: 649-55(Apr. 1961).

Erythropoietic function was studied in ten patients following 80 to 100 r total-body irradiation. The plasma Fe^{59} disappearance rate was measured serially up to 64 days following irradiation, and red cell uptake of Fe^{59} was measured in four patients. All ten patients demonstrated a marked increase in the $T_{½}$ of the plasma iron disappearance rate during the week following irradiation. There was a second increase in the $T_{½}$ 22 to 29 days following irradiation in all six patients studied, indicative of radiation injury and prolonged functional change. Two patients with normal marrows did not demonstrate changes in their red cell uptake of iron, whereas two patients with chronic lymphatic leukemia had significant depression of uptake. At this dose level, the $T_{½}$ of the plasma radioiron disappearance seems to be a sensitive indicator of radiation damage, is associated with a decrease in plasma iron turnover, and increases prior to changes in the hemoglobin concentration or reticulocyte count. (auth)

16839 THE EFFECT OF IRRADIATION ON NATURAL HEMAGGLUTININS OF MICE. Lottie Kornfeld and C. Phillip Miller (Univ. of Chicago). J. Immunol., 84: 73-6 (Jan. 1960).

Naturally occurring agglutinins for chicken red cells were studied in normal and x-irradiated CF-1 mice. Following total-body exposure to 550 or 700 r, the mean hemagglutinin titers of individual mouse sera declined gradually over a 10- to 12-day period and returned to normal levels by the 19th to 21st day postirradiation. This effect of irradiation was not demonstrable with pools of sera. Titers of individual sera from irradiated mice were distributed over a wider range than titers of sera from normal mice. (auth)

16840 THE EFFECT OF IRRADIATION ON NATURAL BACTERICIDINS OF MICE. Lottie Kornfeld, Carolyn W. Hammond, and C. Phillip Miller (Univ. of Chicago). J. Immunol., 84: 77-81(Jan. 1960).

Normal mouse sera in the presence of complement were found to be bactericidal for Escherichia coli. Following whole-body exposure of CF-1 mice to 600 r, their serum bactericidal activity was slightly elevated for 1 to 3 hr, then fell rapidly and was no longer detectable 9 to 12 hr after irradiation. It returned to normal levels 11 to 14 days after irradiation. Nevertheless, the data presented do not indicate that loss of serum bactericidal activity is an important factor in the development of postirradiation bacteremias in mice. (auth)

16841 STUDIES ON ANAPHYLACTIC SHOCK IN THE MOUSE. III. EFFECTS OF SINGLE WHOLE-BODY X-IRRADIATION OF 500 ROENTGENS. Perry Morgan, Noble P. Sherwood, Alvar A. Werder, and Karl Youngstrom (Univ. of Kansas School of Medicine, Kansas City and Univ. of Kansas, Lawrence). J. Immunol., 84: 325-32(Mar. 1960).

The effects of x irradiation (500 r) on the anaphylactic response of mice sensitized with bovine albumin-adjuvant emulsion and challenged with bovine albumin solution were studied. X irradiation given 0.125, 2, 4, 6, or 8 days before or 2, 4, or 6 days following sensitization failed to enhance the anaphylactic sensitivity when the interval between sensitization and challenge was 7 days. X irradiation given 0.125, 2, 4, 6, 8, 10, 12, or 14 days before or 2, 4, 6, or 8 days after sensitization depressed the anaphylactic sensitivity of mice challenged 10 days after sensitization as measured by mortality incidence and changes in rectal temperatures. In general, a depressive effect of x irradiation on the anaphylactic response was observed in mice exposed 2, 4, 6, 8, or 10 days prior to or 2 days following sensitization when challenge was made 14, 21, 28, 35, or 42 days postsensitization. An enhancement of susceptibility to fatal anaphylaxis was discernible in sensitized animals receiving x irradiation 4 days or more following sensitization when the interval between sensitization and challenge was 14, 21, or 28 days. No effect of x ray on mortality incidence or change in rectal temperature was observed when the interval was 35 or 42 days. (auth)

16842 STUDIES ON ANTIBODY FORMATION. EFFECTS OF X-IRRADIATION ON ADAPTATION FOR THE SECONDARY RESPONSE OF RABBITS TO BOVINE γ-GLOBULIN. Richard J. Porter (Univ. of Michigan, Ann Arbor). J. Immunol., 84: 485-90(May 1960).

The effects of whole-body x irradiation of rabbits on the adaptation for a secondary antibody response were studied under various conditions. X ray in a dose of 550 r 24 hr before a first injection of bovine γ-globulin prevented both adaptation and antibody formation, as measured by hemagglutination of tannic acid-coated erythrocytes. X ray during the latent period between the first and second injections destroyed or markedly depressed adaptation. However, when x irradiation in this period was followed 24 hr later by an injection of antigen, adaptation for a later secondary response was either preserved or re-established. These results are interpreted to mean that during a secondary response at least part of the adaptation for subsequent secondary responses arises from the interaction of antigen with an adapted system. This suggests that the individual cells which produce antibody may later become adapted for a secondary response. (auth)

16843 ALTERATIONS IN SERUM LYSOZYME AND PROPERDIN TITERS OF MICE FOLLOWING X-IRRADIATION OR TREATMENT WITH ZYMOSAN OR ENDOTOXIN. William A. Hook, Warren F. Carey, and Louis H. Muschel (Walter Reed Army Inst. of Research, Washington, D. C.). J. Immunol., 84: 569-75(June 1960).

Inoculation of mice with Zymosan or endotoxin caused an initial decline and subsequent rise in lysozyme titers that was similar but not identical with changes in properdin titer. Mice responded to irradiation with progressively decreasing lysozyme levels whereas properdin titers rose to above normal shortly after irradiation and then fell to normal or below normal levels. The serum lysozyme titer in mice thus appeared to be a more consistent indicator of irradiation damage than the properdin titer. Lysozyme could not be substituted for properdin in vitro for the lysis of paroxysmal nocturnal hemoglobinuria erythrocytes, tannic acid treated-erythrocytes, toxoplasmacidal activity, or for the inactivation of C'3. A lysozyme depleted serum (RL) containing complement and properdin possessed full activity in these systems. (auth)

16844 CROSSLINKING OF DRY DEOXYRIBONUCLEIC ACIDS BY ELECTRONS. J. T. Lett, K. A. Stacey, and P. Alexander (Royal Cancer Hospital, London). Radiation Research, 14: 349-62(Apr. 1961).

Desoxyribonucleic acid from protein was irradiated with 1- to 2-Mev electrons and changes in the physicochemical properties were measured. The changes were essentially the same in dry samples and those containing 25% water. The principal effect of radiation was a decrease in viscosity. Changes were interpreted as the result of the production of branched molecules by the simultaneous formation of cross-

links and main-chain scissions. Possible reaction mechanisms involved are discussed. (C.H.)

16845 DEGRADATION OF DRY DEOXYRIBONUCLEIC ACID BY POLONIUM ALPHA-PARTICLES. P. Alexander, J. T. Lett, P. Kopp, and Ruth Itzhaki (Royal Cancer Hospital, London). Radiation Research, 14: 363-73(Apr. 1961).

Thin films of desoxyribonucleic acid were irradiated with α particles from polonium, and their physical properties were determined by light-scattering and viscosity measurements. The change in viscosity was the same for films containing 0, 20, and 80 parts of water per 100 parts of DNA; in this respect, α-irradiation is quite different from irradiation with 2-Mev electrons. So long as oxygen was present the molecular weight and the square of radius of gyration of the molecule fell in unison. All the data are consistent with the assumption that the molecule was severed. A main-chain break was produced for every 650 ev of energy deposited; this indicates that this process occurred whenever one α particle traversed a molecule of DNA. In the absence of oxygen the molecular weight did not fall; this was attributed to a limited amount of crosslinking which gave a branched molecule. The viscosity, unlike the molecular weight, was not affected by branching. The crosslinking was ascribed, by analogy with the irradiation with electrons, to the production of isolated active points by the δ rays associated with the α particles. (auth)

16846 THE EFFECT OF X-IRRADIATION ON VARIOUS MOUSE STRAINS DUE TO THEIR GENETIC BACKGROUND. I. LETHALITY AFTER ACUTE IRRADIATION. H. Frölén, K. G. Lüning, and C. Rönnbäck (Research Inst. of National Defense, Sundyberg, Sweden). Radiation Research, 14: 381-93(Apr. 1961).

Acute whole-body irradiation of male mice from an albino strain and from CBA gave an $LD_{50(30)}$ of 446 r and 748 r, respectively; for the F_1 between them, 670 r, and for the F_2, 670 r. Comparison between C3H and CBA gave 668 r and 748 r, respectively; for the F_1, 725 r, and for the F_2, 745 r. In all, 4524 male mice were tested. The results show that the resistance cannot be ascribed solely to the action of dominant genes. The survival time for those that died before the thirtieth day showed no difference between the series, which indicates that the F_1 in this respect does not exhibit an heterotic effect. (auth)

16847 LEUKEMIA AND RETICULAR NEOPLASMS IN THE MOUSE AFTER INTERMITTENT IRRADIATION. James T. Duhig and Shields Warren (New England Deaconess Hospital, Boston). Radiation Research, 14: 404-20(Apr. 1961).

The effects of varying total doses of intermittent total-body x irradiation on the development of tumors of the reticuloendothelial system of A strain mice are reported. Three main groups were distinguished: (1) generalized lymphoid leukemia or lymphosarcoma, (2) myeloid leukemia, and (3) localized reticular neoplasms. The only reticular tumor seen in control mice with any frequency was a generalized lymphoid leukemia without thymic enlargement. Radiation resulted in a marked increase in incidence of lymphoid leukemia with thymic enlargement. Lymphoid leukemia without thymic enlargement was little affected by radiation. A number of mice showed aplastic or hypolastic bone marrows, predominantly those with lymphoid leukemia and significantly more in female mice and animals with nonthymic lymphoid leukemia. It is suggested that depression of lymphocytes and myeloid cells may be an important factor in the pathogenesis of lymphoid leukemia after irradiation. Myeloid leukemia and localized reticular neoplasms were rare in these mice. Their incidence appeared to be increased after radiation, consistent with the increase in all types of tumors observed in the irradiated animals. (auth)

16848 LATENT RADIATION DAMAGE AND SYNCHRONOUS CELL DIVISION IN THE EPIDERMIS OF AN INSECT. III. SPONTANEOUS REVERSAL OF EFFECTS LEADING TO DELAY DURING MITOSIS. W. F. Baldwin (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiation Research, 14: 426-31(Apr. 1961).

Molting in the insect Rhodnius, Order Hemiptera, is initiated by a single meal of blood. After the meal, and in response to a stretching stimulus from the abdomen, neurosecretory cells of the insect brain produce a secretion that activates the thoracic gland, which produces the molting hormone. Whole-body irradiation was found to delay initiation of division in nymphs. Results of studies on fourth-stage nymphs irradiated over the abdomen only indicate the spontaneous reversal of a part of the latent radiation damage. Reaction mechanisms involved are discussed. (C.H.)

16849 EFFECTS OF RADIATION ON NITROGEN AND PHOSPHORUS EXCRETION BY THE COCKROACH, PERIPLANETA AMERICANA L. D. R. A. Wharton and Martha L. Wharton (Quartermaster Research and Engineering Center, Natick, Mass.). Radiation Research, 14: 432-43(Apr. 1961).

Starved male cockroaches exposed to 10000 rads of β rays consume more water than unirradiated controls. They excrete more nitrogen than controls. The difference is pronounced soon after irradiation and continues for several days, after which there is a rise in output by the controls while the nitrogen excretion by the irradiated cockroaches continues to decline. The adult American cockroach excretes very little of its nitrogen as uric acid; the identity of the nitrogenous constituents remains to be investigated. Phosphorus excretion by the irradiated cockroaches follows a different pattern from that of total nitrogen or uric acid. There is no significant difference between the two groups during the first week, however, during the second week the irradiated insects excrete less than the controls. Excretion by the controls rises between the seventh and twelfth days in the manner of nitrogen. The inorganic phosphorus excreted by the cockroach is orthophosphate. There is no strong evidence that the radiation injury is centered in the nucleic acids under the conditions of radiation used, and it is suggested that increased cellular permeability may be the primary lesion. (auth)

16850 EFFECTS OF PREDNISOLONE ON THE SERUM LEVEL OF GLUTAMIC OXALACETIC TRANSAMINASE IN THE WHOLE-BODY IRRADIATED RABBIT. G. Parigi, V. Fantin, G. L. Vaccari, E. Manzini, and R. Bergonzini (Università, Modena, Italy). Radiobiol., radioterap. e fis. med., (3) 15: 444-9([1960]). (In Italian)

As a supplement to a preceding study on the behavior of the values of glutamic oxalacetic transaminase in animals exposed to radiotherapy, a study was made of the variation of the values of this enzyme in rabbits after whole-body irradiation (total body dose of 800 and 1200 r) as a result of treatment with prednisolone. Modifications of the serum value of the enzyme were observed in animals exposed to 1200 r. The administration of the corticosteroid hormone, especially if given before the irradiation, causes a smaller increase in the enzyme level, at least in the first 72 hr of the study. The results and their probably pathogenic mechanisms are discussed. (tr-auth)

16851 EFFECTS OF RADIATION ON LIVING CELLS. T. C. Carter (Medical Research Council, Harwell, Berks, Eng.). p.150-63 of "Atomic Energy Waste. Its Nature,

Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

The effects of radiation on living cells are reviewed and the somatic and genetic effects of radiation are discussed in detail. The genetic effect of man-made radiations on the future population of Great Britain is estimated. (C.H.)

16852 SOME ASPECTS OF THE INFLUENCE OF ENVIRONMENT ON THE RADIOSENSITIVITY OF MICRO-ORGANISMS. F. J. de Serres (Oak Ridge National Lab., Tenn.). p.196-216 of "Symposia of the Society for General Microbiology. Number XI. Microbial Reaction to Environment." 1961.

Studies on the radiobiology of various micro-organisms have shown that marked changes in radiation sensitivity can be obtained by any one of a number of different environmental or biological factors. One is particularly impressed by the extreme variability of the radiation response, whether it is measured in terms of the shape of survival curves or the fraction of cells surviving treatment. Equally impressive is the complete lack of experimental evidence for any organism that shows the same effect after irradiation with some constant dose regardless of how the treatment is given. The variability in response is often so great that in many cases comparable results can only be obtained by repeating experiments under exactly the same conditions. Such differences as changes in the age of the culture; the culture medium; the temperature before, during, and after treatment; growth and plating media; pH; oxygen tension; and the timing of various operations are all important factors in determining the ultimate response. A number of hypotheses have been suggested to account for the marked variation observed in radiosensitivity under certain experimental conditions. It seems most probable that one or a combination of these hypotheses will be able to bring these observations into an ordered picture in the future. However, at the present time a complete generalization of all of the facts is not possible. 64 references. (auth)

Radiation Sickness

16853 (AF-SAM-61-3) RADIOPROTECTION IN PRIMATES. A preliminary Report. George S. Melville, Jr., Richard E. Benson, Thomas P. Leffingwell, and George W. Harrison, Jr. (Texas. Univ., Austin. Radiobiological Lab.). Jan. 1961. 8p.

In preliminary studies, the radioprotective drug S,beta-aminoethylisothiuronium dibromide (AET) was administered to Macaca mulatta monkeys receiving four distinct acute doses of x radiation which would be 75 to 100% lethal in untreated animals. AET was given intravenously, intraperitoneally, and orally. In spite of the small numbers of animals studied, the results indicated that AET given intraperitoneally is not effective at doses above 625 r, AET given intravenously is 50% effective at 700 r, Pentobarbital sodium in combination with buffered AET (oral), under certain experimental conditions, may be more effective than either drug alone, and the use of cysteine hydrochloride in conjunction with AET appears to potentiate the action of the isothiuronium compound. (auth)

16854 (JPRS-7595) THE EFFECT OF PENETRATING RADIATION AND CERTAIN CHEMICAL PROTECTIVE AGENTS ON THE PHYSICAL ENDURANCE OF ANIMALS. S. Y. Arbuzov, A. M. Stashkov, and V. P. Korotkova. Translated from Formakol. i Toksikol., 23: 459-64(Sept.-Oct., 1960). 10p.

An apparatus is described that was designed to measure work capacity in mice. Results are reported from a study of the effect of x radiation and certain chemical protective agents on the physical endurance of mice. Mercamine or unithiol given prior to irradiation protected against radiation sickness, including disturbance in work capacity. (C.H.)

16855 (JPRS-7864) THE ROLE OF THE ADRENAL GLANDS IN RELATION TO THE ACTION OF THE RADIATION TOXEMIC FACTOR. L. A. Buldakov. Translated from Patol. Fiziol. i Eksptl'. Terap., 4: No. 6, 49-53(Nov.-Dec. 1960). 7p.

Data are presented which indicate that the adrenal glands play an important part in the inhibition of early radiation toxemia in rats. Administration of homologous serum of irradiated adrenalectomized animals to adrenalectomized rats accelerated the mortality rate, while homologous serum from animals irradiated without a preliminary adrenalectomy retarded the mortality rate. Parenteral administration of the serum of irradiated and nonirradiated dogs reduced the mean life span of adrenalectomized rats from 23 to 11 days. The serum of healthy dogs induced lymphopenia and eosinopenia in rats, whereas the serum of irradiated dogs induced lymphocytosis. (C.H.)

16856 (JPRS-7956) THE EFFECT OF TOTAL X-RAY IRRADIATION ON THE REGENERATION OF THE SCIATIC NERVE IN A RABBIT. V. S. Vinogradov. Translated from Arkh. Anat. Gistol. i Embriol., 39: No. 11, 44-50(Nov. 1960). 11p.

The regeneration of injured sciatic nerve was studied in rabbits with radiation sickness. Whole-body exposure to doses of 300, 600, and 900 r did not alter the general pattern of new formation and growth axones. The character of degeneration and regeneration was altered and a delay was observed in the development of these processes. It was concluded the suppressive effect on regeneration of nerve is a result both of the direct effect of x rays and the acute radiation sickness that developed after radiation exposure. (C.H.)

16857 (JPRS-7957) ON THE PROBLEM OF THE REGENERATION OF TUBULAR BONE IN ACUTE RADIATION SICKNESS. T. L. Sopova. Translated from Arkh. Anat. Gistol i Embriol., 39: No. 11, 51-9(Nov. 1960). 15p.

Dogs were exposed to 300 r of x radiation and the femur was fractured 1.5 to 2 hr later. The regeneration of bone was compared with that in unirradiated controls. No basis was found for associating the delay in healing of the fractures directly with the effects of irradiation. Results are reported from clinical observations, x-ray examinations during the course of healing, and studies of the histologic picture in dogs sacrificed at various times after irradiation and fracture. (C.H.)

16858 (JPRS-7973) INGROWTH OF A FREE CUTANEOUS AUTOTRANSPLANT DURING DIFFERENT PERIODS OF ACUTE RADIATION SICKNESS. K. K. Zaytseva. Translated from Arkh. Anat., Gistol. i Embriol., 39: No. 11, 68-73(Nov. 1960). 9p.

Results are reported from a study on the effects of radiation sickness on the growth of skin autotransplants in swine subjected to flame burn over about 10% of the body. It was concluded that adaptation of autotransplants in irradiated animals depends on the period of the acute radiation sickness in which the transplant is made and on the severity of the disease. During severe radiation sickness numerous hemorrhages lead to partial necrosis of the transplanted tissue and delayed adaptation of the skin to the transplant.

During recovery from radiation sickness the autotransplants took well. (C.H.)

16859 PREVENTION OF BONE MARROW HETEROGRAFTING. USE OF ISOLOGOUS THYMUS IN LETHALLY IRRADIATED MICE. Charles C. Congdon and Dorothy B. Duda (Oak Ridge National Lab., Tenn.). A.M.A. Arch. Pathol., 71: 311-23(Mar. 1961).

Isologous thymus was shown to prevent the therapeutic action of rat bone marrow in lethally irradiated mice. Histologic study of the experiment showed that thymocyte-like cells accumulate in the spleen red pulp of the irradiated animals within 24 hours after injection. This was in contrast to the finding that, with spleen injection after irradiation, lymphocytic cells accumulated in the white pulp. In this situation, evidence for the immunologic competence of injected thymus cells lies in the transplantation and subsequent rejection of rat bone marrow in experimental mice as opposed to continuation of the transplantation-repopulation process in appropriate control mice. In addition to this there was striking histologic evidence, particularly in the spleen of the host animal, that Ab-forming and plasma cells appeared in large numbers before the rat marrow graft was rejected. After rejection of the transplant, germinal center restitution in the spleen white pulp and lymph nodes was observed. Other isologous tissues, e.g., blood, spleen, lymph nodes, and bone marrow, prevented permanent transplantation of rat bone marrow, as would be expected. Isologous liver, kidney, and heart muscle also prevented the therapeutic action of rat bone marrow under the circumstances of these experiments. Where histologic studies were carried out, Ab-forming and plasma cell proliferation in the spleen preceded rejection of the marrow graft. Germinal center regeneration also was noted. (auth)

16860 MODIFICATION OF IRRADIATION INJURY IN THE MONKEY BY BONE MARROW TRANSPLANTATION. B. G. Crouch and Richard R. Overman (Univ. of Tennessee Medical Units, Memphis). Blood, 17: 444-56(Apr. 1961).

Thirty-two adult monkeys were given a single dose of total-body x irradiation of 650, 700, or 800 r. An attempt was made in 24 of the animals to alter the acute phase of the radiation injury to hematopoietic tissues sufficiently to prolong the life of the animals by post-irradiation administration of homologous bone marrow. The other 8 animals served as irradiated non-treated controls. Of the 24 bone marrow treated monkeys, 5 survived for more than 30 days post-irradiation. However, a total of 16 animals showed some recovery of the peripheral blood elements toward normal, which seems to indicate that the bone marrow graft may have been functional in these animals. The causes of death in the face of a recovering bone marrow are discussed with regard to immunological reactions, including the "foreign bone marrow reaction," and other contributing factors. (auth)

16861 THE MECHANISM OF THE PROTECTIVE ACTION OF DITHIOLS AGAINST RADIATION. E. Ya. Graevskii and M. M. Konstantinova (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 1219-22(Feb. 11, 1961). (In Russian)

White mice (18 to 20 grams in weight) were irradiated with a lethal dose of 900 r from a Co^{60} source. The mice were then given doses of 20, 14 and 9 mg of unithiol, and 1.0 and 0.75 mgs of dimercaptopropionic acid at intervals of 15, 20, 30, 40, 45, 50, 60, 90, 120 and 180 minutes after irradiation. The change in oxygen content in the liver and spleen was followed polarigraphically, and correlated with survival. It was found that the drop in oxygen content in the liver and the spleen attained a maximum 20 to 120 minutes after injection with 20 mg unithiol and this drop in oxygen content could be correlated with a 30% maximum survival in the injected animals compared to no survivals in the controls. Analogous results were obtained with dimercaptopropionic acid. It is concluded that the protective action of these dimercapto-compounds is due to the occurrence of a lack of oxygen in radiosensitive organs. The mechanism as to how the lack of oxygen is created is not clear at present. (TTT)

16862 CHEMICAL PROTECTION OF MAMMALIAN TISSUES. J. R. Maisin and D. G. Doherty (Armed Forces Inst. of Pathology, Washington D. C. and Oak Ridge National Lab., Tenn.). Federation Proc., 19: 564-72(July 1960).

The general characteristics of agents known to afford protection against the effects of ionizing radiations are reviewed and their modes of administration and action are discussed. Emphasis is placed on the protection afforded mammalian tissues that are presently considered to be the most radiosensitive. Although the two best compounds, cysteamine (MEA) and 2-aminoethylisothiourea (AET), may be too toxic for extensive human use at high radiation dose levels, they should prove useful in furthering the understanding of the function of protective compounds in mammalian tissues. Radioprotective chemicals with low toxicity and differential distribution to normal and tumor tissue would find considerable application in radiotherapy. 150 references. (C.H.)

16863 ADVANCES IN RADIATION IMMUNOLOGY. T. Makinodan (Oak Ridge National Lab., Tenn.). Federation Proc., 19: 586-9(July 1960).

Data are reviewed from a number of studies on the radiosensitivity of antibody-producing mechanisms in animals exposed to whole-body irradiation. Data are interpreted as indicating that the secondary immune status of intact animals is more resistant to sublethal doses of whole-body irradiation than the primary immune status. Results are summarized from studies on antibody response during the maximum depression period after exposure to various doses of x radiation, cellular changes, the recognition factor in antibody formation, and modification of the immune mechanism in irradiated mice. The feasibility of the in vivo tissue culture method was investigated as a quantitative model for studies on the sequence of events involved in antibody formation. Results from preliminary studies are reported. The number of spleen-like cells per gram of mouse was calculated, based on data from the studies. (C.H.)

CHEMISTRY

General and Miscellaneous

16864 (ANL-6317) A CONTRIBUTION TO THE STUDY OF THE REDUCTION OF UF_4 TO URANIUM METAL. Jovan Milosavljevich and Jerome Baird (Argonne National Lab., Ill.). Feb. 1961. Contract W-31-109-eng-38. 38p.

Reduction of small charges of uranium tetrafluoride with magnesium proved to be successful. By hand-tamping of UF_4–Mg blend, tap densities ranging between 3.1 and 3.4 g/cc were obtained. The reduction yields for these densities ranged from 72.79 to 93.71%. In the case of machine-compacted UF_4–Mg blend having tap densities from 3.58 to 3.68 g/cc, reduction yields were higher, ranging between 91.45 and 97.2%. Machine-compacted blends gave much more uniform temperature distribution curves during the preheating period, as a result of higher tap densities. The best yields were obtained by firing a machine-compacted blend containing 5% Mg excess at a furnace temperature of 650°C, giving an average crude metal yield of 96.3%. However, the high carbon content of 174 ppm in the crude uranium biscuits obtained by compacts reduction, as a result of hydrocarbon binder presence, appeared to be a disadvantage. Attempts were also made to demonstrate the initiation of the reduction reaction at temperatures lower than 500°C by taking x-ray-diffraction patterns of the samples of the UF_4–Mg charges heated up to various temperatures. (auth)

16865 (CF-61-3-120) THE OXIDATION OF FLUORESCEIN IN OXYGENATED HIGH-TEMPERATURE WATER (SUMMARY OF LOOP RUNS G-154 THROUGH G-157). J. C. Griess (Oak Ridge National Lab., Tenn.). Mar. 29, 1961. Contract W-7405-Eng-26. 6p.

A series of exploratory experiments was carried out to determine the rate at which fluorescein is oxidized in oxygen-containing alkaline solutions. The oxidation of fluorescein followed a first-order reaction rate. The half life of the fluorescein color disappearance was about 1 min at 275°C, 3 min at 250°C, and 6 min at 225°C. At all temperatures when the concentration of the dye had been reduced to an undetectable level only about half of the carbon originally in the molecule had been oxidized to carbon dioxide, indicating that some intermediate compound(s) was formed. Oxidation of all the carbonaceous material to carbon dioxide required 20 to 25 hr at 275°C. (auth)

16866 (GAT-280) URANIUM HEXAFLUORIDE: A SURVEY OF THE PHYSICOCHEMICAL PROPERTIES. R. DeWitt (Goodyear Atomic Corp., Portsmouth, Ohio). Aug. 12, 1960. Declassified June 13, 1960. Contract AT-(33-2)-1. 163p.

A handbook containing all available current physicochemical data on UF_6 is presented. Every effort was made to obtain and consider all reports of original data for incorporation in the compilation. One hundred and forty nine references are given. (J.R.D.)

16867 (IS-267) URANIUM GLASSES. III. URANIUM PHOSPHATE GLASSES. C. D. Wirkus and D. R. Wilder (Ames Lab., Ames, Iowa). Feb. 1961. Contract W-7405-Eng-82. 23p.

The maximum concentration of UO_2 (40 wt.%) was determined for stable, usable phosphate glasses. A number of such glasses were developed and probable structures are suggested. The properties of a typical high-urania-content phosphate glass are discussed and the effects of various intermediates and modifiers are considered. (auth)

16868 (KAPL-980(Del.)) THE INTERACTION OF TRITIUM WITH POLYMERIC MATERIALS. L. M. Dorfman, B. A. Hemmer, and C. F. Pachucki (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 21, 1953. Decl. with deletions Mar. 8, 1960. Contract W-31-109-eng-52. 28p.

The effect of tritium on a number of polymeric materials was investigated. The exchange rates of tritium with the following polymers increased in the order: Hypalon X-53 <Hycar DR-25 <GR-S, X-478 <Natural Rubber <Neoprene Type WRT. The extent of hardening as a result of exposure to tritium was in the following increasing order: GR-S, X-478 ≤Hycar DR-25 <Natural Rubber <Neoprene Type WRT <Hypalon X-53 <Hypalon X-52 <Hypalon X-50 <Buna-N*. Elongation tests indicated a differing hardening mechanism in the case of Neoprene Type WRT and Natural Rubber. Tritium fluoride was the only decomposition product identified in the case of Teflon and Kel-F exposed to tritium. On the basis of these experiments, GRS, X-478 and Hycar DR-25 seemed to be the most suitable of the candidate rubbers for use as gasket materials and valve seats. (auth)

16869 (NASA-TN-D-768) REACTION OF COPPER AND FLUORINE FROM 800° TO 1200°F. Patricia M. O'Donnell and Adolph E. Spakowski (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1961. 15p.

The reaction of Cu foil and gaseous F_2 was studied in an all-glass apparatus at a pressure of ~200 mm Hg and temperatures from 800 to 1200°F. The reaction rate varied with pre-run sample treatment, temperature, and time. The higher the preheat temperature was, the lower the F_2 consumption. The reaction was found to be controlled by a diffusion process through a solid barrier. Initially, the simple power law $y^n = kt$ applied at the lower temperatures, and the log-law $y = k \log(t^{1/4} + 5)$ applied at the higher temperatures, where y is amount F_2 consumed per unit area of Cu surface and t is time. At longer times, all the data tended to fit the asymptotic law $y = k(1 - e^{at})$. (D.L.C.)

16870 (NP-9979) RESEARCH ON SYNTHESIS OF 1000°F STABLE BASE FLUIDS. Quarterly Progress Report, August 1, 1960 to October 31, 1960. J. W. Dale, E. A. McElhill, P. G. Scheurer, G. R. Wilson, and G. J. O'Neill (Monsanto Chemical Co., Everett, Mass.). Nov. 25, 1960. Contract AF33(616)-6851. 25p.

The fluorine research program was continued with perfluoropolyaromatic structures such as polyphenylether analogues as the main target. In the stepwise approach to tetrafluorobenzenes, which are valuable precursors for the above systems, a route was found to 1,2,4,5-tetrafluorobenzene that largely avoids the use of the tedious, low-yield Schiemann reaction. Commercially-available 2,5-dichloronitrobenzene can readily be converted to 2,4-dichloro-5-fluoronitrobenzene in three steps with an over-all yield of about 50%. Unfortunately, initial attempts at the next step, which is the fluorination of the above product to 2,4,5-trifluoronitrobenzene, have given only 10% yield, however, considerable improvement may be possible. The conversion of the latter compound to the sym-tetrafluorobenzene by the conventional Schiemann method is reported in the literature in 40% yield. A route to 1,2,3,5-tetrafluorobenzene by anal-

ogous methods is also being investigated. Both should give dibromo analogues in good yield, whose difunctionality (in Grignard reactions, for example) should assist in synthesis of several polyaromatic-type structures. In the CoF_3 fluorination process, several runs were carried out on the fluorination of biphenyl, phenyl ether, benzotrifluoride, fluoranthene, and 1,2-diphenoxyethane to convert them to their perfluorocyclohexyl analogues. Optimum fractions were separated containing the desired perfluorocarbons along with hydrogen-containing impurities. These are being treated with elemental fluorine in attempts to obtain hydrogen-free materials prior to their defluorination over hot iron or nickel to the perfluoroaromatic structures. In the Simons electrochemical fluorination approach to C_8F_6, two runs were carried out on isophthalyl fluoride. The cell residues, after removal of HF, were treated with alkali to convert any $C_6F_{10}(COF)_2$ formed to the corresponding sodium salt. Pyrolysis of resulting solid from one run gave only a negligible yield of volatile liquid. Fractionation of this produced only 4 to 5 drops of liquid boiling in the range of cyclic-C_6F_8 and the latter was not positively identified. The bulk of the liquid apparently polymerized on warming to give a more viscous liquid which will be examined further. The product of the second run has not yet been pyrolyzed, but a test portion shows the same qualitative behavior as the first. In the non-fluorine area of the project several more model compounds were synthesized and tested for thermal stability. The most stable of these were tetrakis (o-biphenyl)silicates (919°F), 2,2′,4′-triphenylphenyl ether (896°F), and benzyl-o-terphenyl (793°F). Other compounds, including a high molecular weight aromatic ether and several silane derivatives, have been prepared but not tested. (auth)

16871 (NP-10048) THE DETERMINATION OF THE COVERAGE ON NICKEL AND STEEL DURING ELECTROLYTIC HYDROGEN EVOLUTION. Technical Report No. 4. J. O'M. Bockris (Pennsylvania. Univ., Philadelphia). Feb. 28, 1961. Contract Nonr 551(22) NR 036-028. 51p.

The galvanostatic double charging method previously developed in this project was applied to determine the coverage of nickel cathodes with adsorbed atomic hydrogen in 2 N sodium hydroxide solutions. Anodic current densities were varied from 0.05 A cm^{-2} to 1.8 A cm^{-2}. The plateau indicating absence of readsorption was found between 0.6 and 1.8 A cm^{-2}, for a constant cathodic current density of 10^{-4} A cm^{-2}. The variation of the adsorbed hydrogen over cathodic current densities ranging from 10^{-6} to 10^{-1} at a constant anodic current density of 1 A cm^{-2} was calculated and the coverage estimated. The mechanism of the hydrogen evolution reaction was elucidated with the aid of the coverage values obtained. It is shown that the rate determining step is discharge of a water molecule followed by rapid Tafel recombination. The rate constants for these processes and the rate constant for the ionization, calculated with the extrapolated value of coverage for the reversible hydrogen electrode, were determined. A modification of the Tafel equation which takes into account both coverage and ionization is found to be in harmony with the results obtained. A new method for the determination of coverage suitable for corrodible metals is described. This involves the measurement of the rate of permeation of hydrogen by electrochemical techniques which enhances the sensitivity of the method. The relevant diffusion theory suitable for this method is developed. An analysis of the method shows that it can yield embrittlement parameters such as rate constants for transfer of hydrogen from surface to bulk and vice versa, the diffusion constant, and the quantity of hydrogen in the membrane. The method was tested on palladium and the diffusion constant evaluated by five different formulas from the rise and decay transients. Four of these formulas are original and the agreement of the results obtained by all five formulas confirms the validity of the equations derived. The method was applied to nickel and steel. Preliminary data show that the coverage in alkaline solutions tends to 30% of that in acid solutions. Palladated steel membranes were also studied. Evidence that the diffusion behavior depends on past history of the specimen was obtained. (auth)

16872 (NP-10105) BEHAVIOR OF Fe^{4+} IN THE SYSTEM $SrFeO_3-SrTiO_3$. Thomas R. Clevenger, Jr. (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Mar. 1961. Contracts AF 19(604)-6155 and Nonr-184(10). 35p.

Perovskites of the system $SrFeO_3-SrTiO_3$ were prepared and measurements made of their magnetic and electrical behavior. Chemical analysis showed the percentage of Fe^{4+} to vary from 72.5% for $SrFeO_3$ to about zero for $SrFe_{0.1}Ti_{0.9}O_3$; the rest of the iron was in the Fe^{3+} state and electrical balance was achieved by oxygen loss. $SrFe_{1-x}Ti_xO_3$ was antiferromagnetic between x = 0 and x = 0.9, with a Néel temperature below 60°K. A parasitic ferromagnetic component developed when these compounds were cooled in a magnetic field. Its magnitude depended on the temperature and on the magnetic field applied during cooling; its peak value was 0.995 emu/g for x = 0.1. De tailed studies were made on $SrFe_{0.8}Ti_{0.2}O_3$. The conductivity of these perovskites ranged from 10^{-8} mho/cm for x = 1.0 to 10^{-2} for x = 0.0 and showed a marked break at x = 0.8. $SrFeO_3$ was an n-type semiconductor; with the addition of Ti^{4+} the sign of the thermoelectric voltage changed to p type. The activation energy decreased from 0.79 ev for $SrTiO_3$ to 0.05 ev for $SrFeO_3$. The Fe^{4+} content depended on the heat treatment and atmosphere during formation. (auth)

16873 (NYO-9563) MAGNETIC STUDIES OF HIGH-SPIN COBALTOUS COMPOUNDS. VII. SOME THIOCYANATE COMPLEXES. F. A. Cotton, D. M. L. Goodgame, M. Goodgame, and A. Sacco (Massachusetts Inst. of Tech., Cambridge). Mar. 31, 1961. Contract AT(30-1)-1965. 26p.

The compound $[Co(Ph_3P)_2(SCN)_2]$ was studied magnetically and spectroscopically. The data lead to the following conclusions: (1) the compound is tetrahedral; (2) the SCN groups are bound to Co via the sulfur atoms; (3) the position of S-bonded thiocyanate ions in the spectrochemical series is between Cl^- and Br^- as previously shown by Schäffer. Several salts of the $[Co(NCS)_4]^{2-}$ anion were studied magnetically and spectroscopically. A number of important parameters pertaining to the electronic structure and ligand field were evaluated and the effect of bonding the S atom to Hg(II) in moving the $-NCS^-$ ion to a stronger position in the spectrochemical series, as observed by Schäffer, was confirmed. The compound $[Co(Ph_3PO)_2(NCS)_2]$ has been prepared. Comparison of spectral and magnetic data for the compound with similar data for its chloride and bromide analogs shows that in this case the thiocyanate ions are coordinated through the nitrogen atoms. (auth)

16874 (NYO-9566) ELECTRONIC SPECTRA OF SOME TETRAHEDRAL NICKEL(II) COMPLEXES. D. M. L. Goodgame, M. Goodgame, and F. A. Cotton (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). Apr. 14, 1961. Contract AT(30-1)-1965. 36p.

The electronic spectra of eight tetrahedral complexes of nickel(II), viz., $[NiCl_4]^{2-}$, $[NiBr_4]^{2-}$, $[NiI_4]^{2-}$, $[Ni(Ph_3PO)_2Cl_2]$, $[Ni(Ph_3PO)_2Br_2]$, $[Ni(Ph_3PO)_2I_2]$, $[Ni(Ph_3AsO)_2Cl_2]$, and $[Ni(Ph_3AsO)_2Br_2]$, were carefully studied in the region of the two highest energy, spin-allowed bands, ν_3 and ν_2. It is shown that the tetrahalo ions are very sensitive to solvolysis, even by nitromethane and acetonitrile, and that the spectra of the solvolyzed species, most probably $[NiX_3solvent]^-$, especially in the region of ν_2, are quite different from the true spectra of the $[NiX_4]^{2-}$ ions. The true spectra were obtained by measuring solid compounds either by reflectance (ν_3 only) or using mulls. It was then found that if excess X^-, in the form of soluble salts of R_4P^+ or R_4N^+ cations, was added to the solutions the bands of the solvolyzed species could be completely, or almost completely suppressed and the true $[NiX_4]^{2-}$ spectra obtained. From these spectra the values of Δ and B were calculated using Liehr and Ballhausen's complete theory. The order of Δ values was $[NiI_4]^{2-} \sim [NiBr_4]^{2-} < [NiCl_4]^{2-}$. The five mixed ligand complexes were not so readily subject to solvolysis. Their spectra in the ν_3 and ν_2 regions are also reported and analyzed to yield Δ and B values. The oscillator strengths of the bands are reported and discussed. Some remarks on the relatively low magnetic moment of $[NiI_4]^{2-}$ are also given. (auth)

16875 (TID-11255) CHELATION AND OLATION REACTIONS OF AQUEOUS METAL IONS. Annual Progress Report for December 1, 1959—November 30, 1960. Arthur E. Martell (Clark Univ., Worcester, Mass.). Contract AT (30-1)-1123. 89p.

Work on the chelation and olation reactions of aqueous metal ions is described. Quantitative data concerning the interaction of uranyl ions with a number of organic ligands are presented. Equilibrium constants and thermodynamic data pertaining to the polymerization reactions of Fe(III) chelates were determined as an aid in understanding the nature of reactivities and stabilities of iron complexes. As a preliminary step in a thermodynamic study of the chelation and polymerization reactions of alkaline earth and rare earth ions, an investigation was made of the thermodynamics of alkaline earth chelate reactions. The results of non-equilibrium ultracentrifugation of mixed chelates of Zr(IV) and Th(IV) ions in which the total number of potential donor atoms of the ligands exactly matches the coordination number of the metal ion are described. Preliminary solvent extraction studies were made on the interaction of Th(IV) with N-hydroxyethylethylenediaminetriacetic acid. (auth)

16876 (TID-12469) FIRST QUARTERLY REPORT [ON ELECTRO-ANALYTICAL APPLICATIONS IN CHEMISTRY]. (Brussels. Université). [nd]. 18p. (Includes original, 11p.). AEC 201/Euratom 25

The design and construction of model equipment to be used for various electro-analytical applications in the field of nuclear equipment are discussed. The electronic assembly substituted for the cathode ray oscillography is based on the use of triggers connected with electronic chronometers which apply the principle of impulse counters. Circuits other than the control triggers, the chronometers, and their leads are of fairly standard design. A series of successive stages was devoted to the theoretical study of the complete diagram of a chronometric counting unit; the fabrication of a trial prototype; the examination of the prototype's operating characteristics and their improvement; the series production of 12 units; the fabrication of an assembly rack provided with a ventilation system; and the design, fabrication, and finalizing of the entire current supply installation to be used for this electronic assembly. Tests are underway on the entire chronometric assembly. (M.C.G.)

16877 (TID-12576) MECHANISMS OF SUBSTITUTION REACTIONS OF METAL COMPLEXES. Technical Progress Report for 1960-1961. Fred Basolo and Ralph G. Pearson (Northwestern Univ., Evanston, Ill.). Apr. 10, 1961. AT(11-1)-89. Project No. 2. 14p.

A list of published papers on work related to the contract is given and reprints of some papers are included. A discussion of research during the period is presented on substitution reactions of Co III complexes in dimethylsulfoxide, reactions of octahedral complexes of the non-transition metals, synthesis of metal complex linkage isomers, and synthesis and reactions of phosphine metal complexes. (J.R.D.)

16878 (AEC-tr-4557) STRUCTURE OF CESIUM TETRACHLOROCOBALTATE Cs_2CoCl_4 CRYSTALS. M. A. Porai-Koshits. Translated by Lydia Venters (Argonne National Lab., Ill.). from Kristallografiya, 1: No. 3, 291 (1956). 13p.

The crystals of cesium tetrachlorocobaltate Cs_2CoCl_4 are rhombic, a = 9.737, b = 12.972, c = 7.392 A, z = 4, the federovite group D 16/2h = Pnam, K_2SO_4 structural type. The distances Co-Cl in the tetrahedron $CoCl_4^{2-}$ are equal to 2.26 A. The tetrahedron has a slight angular distortion. Each tetrahedron is surrounded by eleven Cs^+ ions, four of which are located at the vertex of the tetrahedron (the mean distance is 3.49 A), five at the center of the edge (the mean distance is 3.67 A), and two at the centers of the tetrahedron faces (the mean distance is 3.94 A). The configuration has two symmetry planes. The coordination numbers of Cs^+ ions are 11 and 9. (auth)

16879 (AEC-tr-4565) NEWER METHODS OF PREPARATIVE ORGANIC CHEMISTRY. III. 2. PREPARATION OF ESTERS, AMINES AND ANHYDRIDES OF PHOSPHORIC ACID. F. Cramer. Translated by Gretchen Riese (Los Alamos Scientific Lab.) from Angew. Chem., 72: 236-49(1960). 75p.

A known method of phosphorylation is discussed. The preparation of pyrophosphates by reaction of isocyanate with carbamylphosphates, the reaction of ketenacylals to give unsymmetrical pyrophosphates, the use of trichloroacetonitrile as an esterifying medium for phosphoric acids, and the preparation of geranyl phosphate and farnesyl phosphate are also discussed along with the preparation and reaction methods for imidazolides of phosphoric acid. (auth)

16880 (DEG-Inf.-Ser.-157) VAPOUR PRESSURE DIFFERENCES OF ISOTOPIC COMPOUNDS: INFRA-RED CONTRIBUTION OF THE DISPERSION EFFECT AS THE CAUSE FOR GREATER VOLATILITY OF HEAVY MOLECULES. P. Baertschi and W. Kuhn. Translated by R. Presser from Helv. Chim. Acta, 40: 1084-1103(1957). 20p.

Examination of the contribution made by infrared, intramolecular vibrations to Van der Waal forces of attraction emanating from the dispersion exchange effect showed that this infrared exchange effect favors greater volatility of molecules containing heavy isotopes. The effect is brought about because the numerical value of the part of attractive forces due to infrared absorption bands is greater for light molecules than for heavy ones. In consequence of this effect, the energy as a function of distance of two (or more) molecules is not the same for light and heavy molecules. In the case of definite examples, the relative volatility of light and heavy molecules will not only depend on the dispersion exchange energy, but

also on other effects, particularly the zero point energy of the vibration of the entire molecule with respect to its position of minimum potential energy in the liquid and solid material. The zero point energy of the vibration of the entire molecule produces a tendency to increased volatility of light molecules. This "normal" effect, which favors volatilization of light molecules, decreases more rapidly with increase in temperature than that due to dispersion exchange effect, which favors volatility of heavy molecules. Therefore an increase in temperature can result in a change of sign in relative volatility. This was actually observed in many cases, heavy molecules being more volatile at high temperatures. In the case of CCl_4 it was found experimentally that the molecules containing the heavy carbon isotope C^{13} were more volatile. The sign and approximate magnitude of the effect were in good agreement with the numerical value obtained by means of the dispersion theory from the position and intensity of infrared absorption bands due to vibration of the C atom in CCl_4. (auth)

16881 (JPRS-7473) NEWS OF THE DEPARTMENT OF CHEMICAL SCIENCES OF THE ACADEMY OF SCIENCES, USSR. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 5, 953-56(May 1960). 11p.

A review is presented of papers on silicates of rare earth elements, spectroscopic investigation of aluminum silicate glass, spectra and structure of anions of the type X_2Y_7 and model organic compounds, naphthalene derivative isomerization mechanism, and on derivatives of iminosulfoacids. Other papers reviewed include those on semiconductor properties and chlorophyll photochemistry, and reactions in the reverse photo-chemical reduction of chlorophyll. (J.R.D.)

16882 (UCRL-Trans-654) ELECTRON TRANSFER BY LIGHT ABSORPTION AND EMISSION IN ELECTRON DONOR-ACCEPTOR COMPLEXES. G. Briegleb and J. Czekalla. Translated from Angew. Chem., 72: 401-13 (1960). 54p.

The optical behavior and energetic state quantities of electron donor-acceptor complexes are discussed along with the ionization energy associated with the affinity of such molecular components. A considerable variation of electron structure in excited states may be assumed from interpretation of characteristic absorption bands of donor-acceptor complexes, resulting in fundamental variation of the reaction possibilities of A^- and D^+ in comparison with A and D acceptor-donor complexes. It is noted that the photochemistry thus seems to promise additional interesting results. (J.R.D.)

16883 NEW COMPLEX COMPOUNDS FORMED BY HEXAFLUORIDES OF MOLYBDENUM, TUNGSTEN, URANIUM WITH FLUORIDES OF CESIUM AND AMMONIUM. N. S. Nikolaev and V. F. Sukhoverkhov. Doklady Akad. Nauk S.S.S.R., 136: 621-3(Jan. 21, 1961). (In Russian)

The synthesis of complex molybdenum, tungsten, and uranium hexafluoride compounds with cesium and ammonium fluorides of the general formula $MMeF_7$ was achieved by a new method based on the reaction of the hexafluorides with alkali metal fluorides in chlorine trifluoride: $ClF_3 \rightleftharpoons ClF_2^+ + F^-$; $n[ClF_2^+ - F^-] + MeF_6 \rightleftharpoons [ClF_2]\ MeF_{6+n}$; $MF + [ClF_2]_n\ MeF_{6+n} \rightleftharpoons M_nMeF_{6+n} + nClF_3$, where Me is Mo, W, and U; M is the alkali. The solubility of the components in chlorine trifluoride at 0° was MoF_6, 95.1 ± 0.5%; WF_6, 99 + 1%; UF_6, 49.13 ± 0.3%; and CsF_3, 16.05 ± 0.4%. The results of a chemical analysis for the synthesized salts are included. (R.V.J.)

16884 THERMAL DECOMPOSITION OF SOME ORGANIC COMPOUNDS IN THE PRESENCE OF DEUTERIUM. L. Radich, I. P. Kravchuk, and R. E. Mardaleishvili (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 136: 657-9 (Jan. 21, 1961). (In Russian)

Studies are made of hydrogen break-off by methyl radicals formed in acetaldehyde, acetone, dimethyl mercury, and di-test-butyl peroxide pyrolisis with D_2. Distributions of deuteromethanes plotted as functions of temperature show that at 500 to 600°C the extent of the reaction does not exceed 0.01 to 5%. Moreover, the methane consists exclusively of CH_3D and CH_4 molecules. Their ratio at the above temperature does not depend on pressure or contact time, indicating the absence of secondary processes. At temperatures exceeding 600°C, the extent of the reaction is 10 to 30%, forming poly-replaced methanes up to CD_4. The latter is produced by secondary processes induced by increased concentrations of deuterium. The data indicate that elementary reaction rate constants determined by comparing the reaction rates of $R + R_1H \rightarrow RH + R$ and $R + D_2 \rightarrow RD + D$ are complicated by secondary processes when the temperature exceeds 500 to 550°C. This suggests that the mechanism of thermal radical exchange with molecular deuterium at temperatures over 600°C does not take place as poly-replaced molecules but as the result of secondary replacement processes. (R.V.J.)

16885 MECHANISMS OF EXCHANGE REACTIONS OF PRIMARY AND SECONDARY ALKYL IODIDES WITH ELEMENTARY IODINE. John E. Bujake, Jr., M. W. T. Pratt, and Richard M. Noyes (Columbia Univ., New York and Univ. of Oregon, Eugene). J. Am. Chem. Soc., 83: 1547-55 (Apr. 5, 1961).

Several primary and secondary alkyl iodides exchange thermally with I^{131} in hexachlorobutadiene between 130 and 200°. If the solutions are saturated with oxygen at one atmosphere, rates of exchange fit the kinetic expression $k_b[RI][I_2]^{1/2}$. Degassed solutions always exchange faster than oxygen saturated ones, but methyl, ethyl, and n-propyl iodides show the same kinetics as with oxygen. Exchange rates of degassed isopropyl and neopentyl iodides also show contributions from a $k_a[RI]$ term. Exchange in degassed ethylene dichloride is 3 to 4 times as fast as in degassed hexachlorobutadiene. Activation energies for k_b are usually about 27 to 31 kcal/mole. Effects of substitution on α carbon are illustrated by the rate sequence methyl < ethyl < i-propyl = sec-butyl. Effects of substitution on β carbon are illustrated by the rate sequence ethyl < n-propyl >> neopentyl. Since the rates of exchange of methyl, ethyl, and i-propyl iodides vary in the opposite direction from the sequence for bimolecular nucleophilic substitution, the explanation proposed suggests that for nucleophilic substitution the effect of added methyl groups on an α carbon is a steric hindrance to solvation by solvent dipoles rather than a steric hindrance to the group attacking the carbon atom itself. (auth)

16886 MECHANISMS OF EXCHANGE REACTIONS OF t-BUTYL IODIDE WITH ELEMENTARY IODINE. John E. Bujake, Jr. and Richard M. Noyes (Columbia Univ., New York and Univ. of Oregon, Eugene). J. Am. Chem. Soc., 83: 1555-9(Apr. 5, 1961).

t-Butyl iodide exchanges with elementary iodine near room temperature by two parallel non-radical mechanisms that are not influenced by light. The bimolecular mechanism is first order each in t-butyl iodide and in molecular iodine and at 25° is significant only in the solvents chlorobenzene and ethylene dichloride that have dielectric con-

stants greater than 5. The rate depends on dielectric constant more strongly than is found for other reactions known to form ion pairs, and it is proposed that the exchange involves an ion pair intermediate $C_4H_9^+I_3^-$. The termolecular mechanism is first order in t-butyl iodide and second order in molecular iodine and shows a dependence on dielectric constant comparable to that for reactions forming ion pairs. It is proposed that the exchange involves either nucleophilic attack by an iodine molecule on a $C_4H_9I_3$ neutral complex or by an I_3^- component of an ion pair on the $C_4H_9I_2^+$ component. (auth)

16887 SOME COMPLEXES OF TERTIARY PHOSPHINES WITH RUTHENIUM(II) AND OSMIUM(II). J. Chatt and R. G. Hayter (Imperial Chemical Industries Ltd., Welwyn, Herts, Eng.). J. Chem. Soc., 896-904(Mar. 1961).

The reactions of $RuCl_3$ and $(NH_4)_2OsCl_6$ with a variety of mono- and ditertiary phosphines are described. The properties, reactions, and structures of the resulting complexes, $[M_2Cl_3(PR_3)_6]Cl$ (M = Ru or Os; PR_3 = PMe_2Ph, PEt_2Ph, $PMePh_2$, or $PEtPh_2$), and cis- and trans-$[MX_2(chelate)_2]$ [chelate = $C_2H_4(PR_2)_2$ (R = Me, Et, or Ph), $CH_2(PPh_2)_2$, and o-$C_6H_4(PEt_2)_2$; X = halogen, SCN], are discussed. (auth)

16888 ETHYLENEDIAMINE ADDITION COMPOUNDS OF METAL PERCHLORATES. Harvey Diehl and H. W. Wharton (Iowa State Univ. of Science and Tech., Ames). J. Inorg. & Nuclear Chem., 17: 120-4(Apr. 1961). (In English)

The ethylenediamine addition compounds of the perchlorates of lithium, magnesium, calcium, strontium, barium, copper, and zinc were prepared by the direct union of ethylenediamine and the corresponding metal perchlorate. The thermal stabilities of these compounds were studied by differential thermal analysis and thermogravimetric analysis methods. (auth)

16889 LABELED ORGANICS IN GAS CHROMATOGRAPHY. Fulvio Cacace (Universita, Rome). Nucleonics, 19: No. 5, 45-50(May 1961).

Uses of C^{14} and H^3 as labels in gas chromatography are described. The labels may be used either in detection or separation of compounds. Radiation detectors designed for use in gas chromatography are discussed, including G-M tubes, ionization chambers, and scintillation and proportional detectors. A method is described in which separated singly- or doubly-labeled compounds are burned to CO_2 and H_2O; thus the activities of only 2 compounds need be measured. It is noted that Br^{80}, Br^{82}, N^{13}, N^{18} and I^{131} are also convenient tracers. (T.F.H.)

16890 AN ANION-EXCHANGE BEHAVIOUR AND STABILITY CONSTANTS OF THE RARE-EARTHS COMPLEXES WITH ETHYLENE DIAMINE TETRA-ACETIC ACID. Nukleonika, 6: 65-6(Jan. 1961). (In Polish)

The anion-exchange behavior and stability constants are found for La^{140}, Ce^{144}, Nd^{147}, Pm^{147}, Eu^{152}, Eu^{154}, Eu^{169}, Tb^{160}, Tm^{170}, and Yb^{175} and ethylenediaminetetraacetic acid-rare earth complexes. (R.V.J.)

16891 OXIDATION OF COLUMBIUM MONOXIDE. W. T. Hicks (E. I. du Pont de Nemours & Co., Wilmington, Del.). Trans. Met. Soc. AIME, 221: 352-6(Apr. 1961).

The oxidation of NbO was studied by a gravimetric technique from 400° to 1200°C in oxygen. In this temperature range the oxidation is characterized by an inductive period of low oxidation rate, which becomes shorter as the temperature increases, followed by a rapid parabolic oxidation. The oxidation of NbO cannot be rate controlling in the oxidation of Nb metal in the temperature range, 800° to 1200°C. (auth)

16892 CATALYTIC RECOMBINATION OF OXYGEN AND HYDROGEN AND/OR DEUTERIUM IN THORIUM OXIDE SLURRIES. (to U. S. Atomic Energy Commission). British Patent 865,729. Apr. 19, 1961.

A method is given for internally recombining O_2 and H_2 and/or D_2 in aqueous thorium oxide slurries. The method consists of providing MoO_3 in the slurry in a concentration of at least 0.01 molar and at a pressure of ≥ 200 psia. Although the recombination reaction can take place at room temperature, the reaction preferably is carried out at ≥ 300°C. The exact amount of MoO_3 required for a sufficiently rapid reaction rate varies with the calcination history of the thorium oxide in the slurry. Recombination rate data are presented. (D.L.C.)

16893 PREPARATION OF ANHYDROUS CERIUM CHLORIDE, URANIUM BROMIDE OR PLUTONIUM FLUORIDE. Kent M. Harmon and Edward Wichers (to U. S. Atomic Energy Commission). U. S. Patent 2,982,603. May 2, 1961.

A process is given for preparing anhydrous metal halides and converting metal oxalates to anhydrous metal halides which are free from oxyhalides. In accordance with one embodiment of the invention, cerous chloride is prepared by passing hydrogen chloride gas over hydrated cerous oxalate below 100°C until no more gas is absorbed and then continuing the treatment at higher temperatures.

16894 PREPARATION OF NEPTUNIUM HEXAFLUORIDE. Glenn T. Seaborg and Harrison S. Brown (to U. S. Atomic Energy Commission). U. S. Patent 2,982,604. May 2, 1961.

A method is described for preparing neptunium hexafluoride by treating the lower fluorides of neptunium, such as neptunium tetrafluoride and trifluoride, with fluorine at elevated temperatures.

16895 PRETREATING URANIUM FOR METAL PLATING. Ralph F. Wehrmann (to U. S. Atomic Energy Commission). U. S. Patent 2,982,702. May 2, 1961.

A process is given for anodically treating the surface of uranium articles, prior to metal plating. The metal is electrolyzed in an aqueous solution of about 10% polycarboxylic acid, preferably oxalic acid, from 1 to 5% by weight of glycerine and from 1 to 5% by weight of hydrochloric acid at from 20 to 75°C for from 30 seconds to 15 minutes. A current density of from 60 to 100 amperes per square foot is used.

Analytical Procedures

16896 (AERE-AM-73) THE SPECTROGRAPHIC ANALYSIS OF BERYLLIUM METAL AND COMPOUNDS USING BARIUM HYDROXIDE–GRAPHITE MIXTURES. M. A. Lund and D. L. G. Smith (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England). Nov. 1960. 20p.

The sample is converted to beryllium oxide and mixed with a diluent consisting of barium hydroxide, graphite powder, and tin oxide. The mixture is charged into graphite cups and the spectrum excited in a d-c arc. Sample spectra are evaluated by comparison with spectra obtained from standard mixtures, either visually or by microphotometry, using tin as an internal standard. The method is suitable for the determination of impurities up to 1000 ppm. (auth)

16897 (AERE-BIB-132) TRITIUM DETECTION AND MEASUREMENT. A bibliography. A. C. Foskett (United Kingdom Atomic Energy Authority. Research Group.

Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1961. 33p.

One hundred and sixty four references are given covering published literature and reports up to the end of 1960 on the determination of tritium. A personal author index, a corporate author index, serial number index to reports, and notes on availability of reports are included. (M.C.G.)

16898 (AERE-M-820) A SIMPLE APPARATUS FOR THE GAS CHROMATOGRAPHY OF POLYPHENYLS. R. W. Wilkinson and J. A. Winter (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1961. 13p.

A simple and cheap gas chromatography apparatus for the analysis of polyphenyls was developed for both solid and semi-liquid samples. The apparatus makes use of model engine glow plugs for the detectors and a column of alumina with no liquid phase. The normal running temperature is 425°C. (auth)

16899 (AERE-R-3490) A STUDY OF INTERFERENCES IN EMISSION AND ABSORPTION FLAME PHOTOMETRY. C. A. Baker and F. W. J. Garton (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1961. 21p.

An atomic absorption double-beam flame photometer was used, in conjunction with an emission flame photometer incorporating fully automatic background correction, to study certain interferences in flame photometry. In particular the suppression effect of phosphate in the determination of calcium and strontium were studied. A general approach to the consideration of inter-element interference and its reduction by various agents was suggested. (auth)

16900 (BMI-1508) THE DEVELOPMENT OF RADIOACTIVE-TRACER QUALITY-CONTROL SYSTEMS. Robert Lieberman, Charles W. Townley, Charles T. Brown, James E. Howes, Jr., Robert A. Ewing, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Mar. 27, 1961. Contract W-7405-eng-92. 26p.

Development of radiometric analytical methods for use in quality control in the manufacture of portland cement is described. A rapid procedure for the analysis of magnesium was developed based on the precipitation of $MgNH_4P^{32}O_4$. Magnesium precipitated is proportional to the reduction in the activity of the precipitating tagged phosphate solution which may be measured directly in the precipitation vessel using a dip-type counter in a simple cell. Calcium is similarly determined as $Ca_3(P^{32}O_4)_2$. Relative accuracy for either element is within ±1 per cent in the recommended ranges. Sulfate analysis is based on the precipitation of $Sr^{89}SO_4$ from an organic-aqueous medium. Iron may be determined by a complexometric titration with EDTA, using $Y_2^{91}(C_2O_4)_3$ as an endpoint indicator. Attempts to titrate aluminum directly using $Ag^{110}IO_3$ as an endpoint indicator were unsuccessful. A complexometric backtitration procedure for aluminum using $Na_3P^{32}O_4$ was also attempted. These radiometric procedures would also be applicable to the quality-control problems of other industries. Activation analysis of portland cement and cement raw materials gave only semiquantitative data. Experimental variables were difficult to control in this method of analysis. (auth)

16901 (GAT-372) DETERMINATION OF SELENIUM IN URINE, VEGETATION, AND SOIL. E. M. Ray (Goodyear Atomic Corp., Portsmouth, Ohio). Mar. 8, 1961. Contract AT(33-2)-1. 12p.

A colorimetric method for the rapid determination of selenium in 5- to 100-microgram quantities is described. Solution of sample material and destruction of organic matter are accomplished by digestion with nitric and perchloric acids. Selenium is reduced by hydrochloric and hydriodic acids to its elementary form which combines with liberated iodine to form a pink color. Selenium has been quantitatively recovered from samples of urine, grass, mud, liver, kidney, bone, cheese, apples, and tobacco. Results were determined with an average precision of ±11 per cent. (auth)

16902 (IDO-12017) THE FLUOROMETRIC DETERMINATION OF MILLIMICROGRAM QUANTITIES OF URANIUM IN AIR DUSTS AND SMEARS. Claude W. Sill and Philip LaFleur (Idaho Operations Office. Health and Safety Div., AEC). Mar. 1961. 21p.

A procedure is discussed for the fluorometric determination of millimicrogram quantities of uranium. Descriptions are given of instrumentation, reagents, sample preparation, fusion techniques, separation procedure, cleaning the equipment, and calculation of the results. The detection limit is ~0.2 mμg of uranium, and the precision of measurement at the 50-mμg level is 5%, both at the 95% confidence level. (B.O.G.)

16903 (IDO-14549) COMPARATIVE BORON ISOTOPIC ANALYSIS. P. Goris, T. D. Morgan, and R. A. Nielsen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 3, 1961. Contract AT(10-1)-205. 9p.

Surface ionization results for natural boron isotopic analysis are in agreement with other recent investigations indicating a B^{11}/B^{10} atom ratio nearer to 4.00 than the more commonly accepted value of 4.31 based on BF_3 analysis. (auth)

16904 (PG-Report-2) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF TRACE THORIUM IN URANIUM SOLUTIONS. T. J. Hayes (United Kingdom Atomic Energy Authority. Production Group. Springfields, Lancs, England). Oct. 28, 1960. 4p.

Thorium is separated from uranium by co-precipitation on lanthanum fluoride. Fluoride is largely removed by evaporation with nitric acid but residual traces are complexed using aluminum chloride solution. Thorium is determined absorptiometrically as the "Thorin" complex. (auth)

16905 (PG-Report-185) ANALYTICAL METHOD FOR THE SPECTROMETRIC DETERMINATION OF URANIUM-235 IN ENRICHED URANIUM METAL AND WASTE MATERIAL. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 10p.

A method for the spectrometric determination of U^{235} in enriched uranium metal and in waste material is described. Non-metallic samples were converted to U_3O_8. The samples were placed in a nickel cup and the cup excited in a hollow cathode. The 4244.12 and 4244.37A lines were scanned with a direct reading spectrometer and the intensities of the lines were measured as peak heights on a recorder chart. The method is applicable to concentration ranges of 5 to 95% U^{235}. The precision was dependent on the state of the uranium and the degree of its enrichment. (M.C.G.)

16906 A METHOD FOR DETERMINING THE OXYGEN-18 CONTENT OF ORTHOPHOSPHATE OR WATER. A. B. Falcone (Veterans Administration Hospital, Madison, Wis. and Univ. of Wisconsin, Madison). Anal. Biochem., 2: 147-51(Apr. 1961). (In English)

A method for determining the oxygen-18 content of orthophosphate or water is described. The method is based on the use of a high voltage discharge to bring about the rapid equilibration of oxygen-18 from water with carbon dioxide. Samples of KH_2PO_4 as low as 2 mg are readily analyzed. (auth)

16907 SPECTROPHOTOMETRIC DETERMINATION OF BORON IN STEEL AND HIGH TEMPERATURE ALLOYS. William L. Karpen (Carpenter Steel Co., Reading, Penna.). Anal. Chem., 33: 738-40(May 1961).

A spectrophotometric method for determining trace amounts of boron in high temperature alloys uses tetrabromochrysazin as reagent. The sample is dissolved in acid and the boron distilled as the trimethyl boron ester. Boron reacts with the reagent to give a colored complex with an absorbance at 540 mμ. (auth)

16908 RAPID SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM AND MOLYBDENUM IN URANIUM MATERIALS. P. R. Kuehn, O. H. Howard, and C. W. Weber (Oak Ridge Gaseous Diffusion Plant, Tenn.). Anal. Chem., 33: 740-4(May 1960).

Vanadium and molybdenum impurities in uranium solutions, especially hydrolyzed uranium fluoride, are determined by rapid spectrophotometric procedure. In process control applications, 30 minutes are required for analyses. Interference due to uranium and iron is easily eliminated. (auth)

16909 DIRECT SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM, TITANIUM, AND TUNGSTEN WITH HYDROQUINONE USING BACKGROUND CORRECTION TECHNIQUE. J. P. McKaveney (Crucible Steel Co. of America, Pittsburgh). Anal. Chem., 33: 744-7(May 1961).

Niobium, titanium, and tungsten in high temperature alloys are determined singly or in combination by direct spectrophotometric procedure. Background correction techniques eliminate the hydrolysis separation step as well as the use of local standards to correct for natural color interference. (auth)

16910 NEW TECHNIQUE FOR THE SEPARATION OF TRIVALENT ACTINIDE ELEMENTS FROM LANTHANIDE ELEMENTS. Fletcher L. Moore (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 748-51(May 1961).

A rapid liquid-liquid extraction procedure is used to separate trivalent actinide elements from lanthanide elements. The actinides are removed from hydrochloric acid-lithium chloride solution with a triiso-octylamine-xylene solution. An order of extractability is reported. (auth)

16911 SOLVENT EXTRACTION OF TECHNETIUM AND RHENIUM WITH PYRIDINE OR METHYL-SUBSTITUTED PYRIDINE DERIVATIVES FROM ALKALINE MEDIA. S. J. Rimshaw and G. F. Malling (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 751-4(May 1961).

Pure technetium and rhenium are extracted from alkaline media with pyridine or methyl substituted pyridine. Distribution coefficient values are obtained for these elements under various extracting conditions. Procedure is given for the preparation of technetium metal. (auth)

16912 DETERMINATION OF SMALL AMOUNTS OF COBALT USING ISOTOPE-DILUTION WITH COBALT-60 K. F. Sporek (Bioferm Corp., Wasco, Calif.). Anal. Chem., 33: 754-8(May 1961).

Trace amounts of cobalt are determined in vitamin B_{12} and biological materials by an isotope-dilution technique combined with a spectrophotometric method. Interference due to copper is overcome by reduction with metallic iron. The procedure employs Co^{60} as the tracer. (auth)

16913 ALPHA COUNTER FOR THE DIRECT DETERMINATION OF PLUTONIUM IN SOLUTION. J. T. Byrne and G. A. Rost (Dow Chemical Co., Denver). Anal. Chem., 33: 758-61(May 1961).

An effective alpha counter is designed which is used directly on the sample, eliminating any chemical or physical treatment. Details of design and operation are given along with the limitations. The counter is rapid and indicates good reproducibility of results. (auth)

16914 SPECTROGRAPHIC ANALYSIS OF SILICON TETRACHLORIDE FOR TRACE AMOUNTS OF BORON. Thomas J. Veleker and Emil J. Mehalchick (Sylvania Electric Products, Inc., Towanda, Penna.). Anal. Chem., 33: 767-70(May 1961).

Trace amounts of boron silicon tetrachloride are determined by emission spectrographic procedure. Preconcentration by aqueous methyl cyanide hydrolysis prepares the sample for the direct current arc technique using a Stallwood jet and argon gas. (auth)

16915 ION EXCHANGE SEPARATION OF CALCIUM AND STRONTIUM. APPLICATION TO DETERMINATION OF TOTAL STRONTIUM IN BONE. Marven A. Wade and H. J. Seim (Univ. of Nevada, Reno). Anal. Chem., 33: 793-5(May 1961).

An ion exchange technique is used for the separation of calcium and strontium. The sample is reacted with EDTA and the complexes are separated on a Dowex 50-X8 resin column. Strontium is quantitatively determined by flame photometry using an oxygen-hydrogen flame. The strontium content oı several bone samples is recorded. (auth)

16916 QUANTITATIVE SPECTROSCOPIC METHOD OF DETERMINING THE ISOTOPIC COMPOSITION OF BORON. B. V. L'vov and V. I. Mosichev. Atomnaya Energ., 10: 279-81(Mar. 1961). (In Russian)

A method is offered for determining the isotopic composition of boron by the emission spectra of BO molecules. The isotopic shift is sufficiently large to be resolved by ordinary spectral apparatus. Microphotographs are given of the analytical lines for $B^{10}O$ and $B^{11}O$ in specimens with 83.3, 51.2, and 19.2 at.% B^{10}. The line intensity ratios are tabulated as functions of isotopic concentration, and the results of B^{10} content determinations are given. (R.V.J.)

16917 METHOD OF SEMIQUANTITATIVE DETERMINATION OF BERYLLIUM IN ROCKS AND SOILS BY PAPER CHROMATOGRAPHY. H. Agrinier (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Chim. Anal., No. 12, 600-2(Dec. 1960). (CEA-1568) (In French)

A method was developed for separating beryllium by ascending paper chromatography. The solvent is a mixture of acetone and nitric acid; quinalizarin is used to show the presence of beryllium. This method is now used to determine beryllium in rocks and soils. (auth)

16918 THE USE OF RADIOLUMINESCENCE, INDUCED BY α-PARTICLES FROM POLONIUM-210, FOR THE ANALYSIS OF ORES AND MINERALS. I. N. Plaksin, M. A. Belyakov, and L. P. Starchik (Inst. of Mining, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 1165-7(Feb. 11, 1961). (In Russian)

Beta and gamma emitters induce a much weaker luminescence in ores and minerals than the same amount of alpha activity. Po^{210} with a half-life of 138.3 days and an alpha emission energy of 5.3 Mev has only one gamma quantum for each 10^5 alpha emissions, and can be mounted as a covered source in a simple arrangement for the identification of minerals by the induced luminescence. Quantitative analyses can be performed by using a phototube to collect the light. Luminescence was observed in calcite, dolomite, fluorite, scheclite and beryl with a 1.8-curie

source of Po^{210}. Since large amounts of beta or gamma activity are required to induce luminescence, the use of an alpha emitter simplifies the shielding requirements. The alpha source can also be used to determine elements which enter into nuclear reactions with alpha particles (α,n; α, 2n eta). (TTT)

16919 ANALYTICAL APPLICATION OF THE HANGING MERCURY DROP ELECTRODE. IV. ANALYSIS OF TRACES OF IMPURITIES IN URANIUM SALTS. W. Kemula, E. Rakowska, and Z. Kublik (Warsaw Univ.). J. Electroanal. Chem., 1: 205-17(Feb. 1960). (In English)

Conditions were worked out for the rapid determination of Cu, Pb, and Cd in U compounds; 10^{-6}% Cd and 10^{-5}% Cu and Pb can be determined by the method proposed. The analysis time, dependent on the compound being analysed, is approx. 1 to 2 hours. The precision is about ±10%. The determination is performed in carbonate solution in which the $UO_2(CO_3)_3^{4-}$ complex is reduced at −1.0 v, which does not influence the reduction of ions with more positive reduction potentials. An investigation was made of the concentration range in which it was supposed that Cu, Pb, and Cd carbonates would precipitate and interfere with the determination. This type of interference was observed when the concentration of Cu exceeded 10^{-6} M, and that of Cd and Pb exceeded 10^{-5} M, i.e., at higher concentrations than those to be determined. It was found that Cu carbonate causes greater disturbances of current than Pb and Cd carbonates. In the case of the Cu oxidation current a few minima were observed. During the reduction of Cu carbonate suspension a few cathodic minima were also noted. (auth)

16920 ESTIMATION OF URANIUM IN ORES BY A. C. POLAROGRAPHY. B. Breyer (Univ. of Sydney) and J. R. Beevers. J. Electroanal. Chem., 1: 345-50(Aug. 1960).

Uranium can be conveniently estimated by a-c polarography. The a-c method permits successful uranium analysis in the presence of a number of ionic species, particularly vanadate ion, which seriously interfere in conventional polarography. Examples illustrating the use of the method for the analysis of uranium ores are given. (auth)

16921 THE DETERMINATION OF URANIUM IN SEA WATER BY PULSE POLAROGRAPHY. G. W. C. Milner, J. D. Wilson, G. A. Barnett, and A. A. Smales (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Electroanal. Chem., 2: 25-38(Jan.-Feb. 1961). (In English) (AERE-R-3227)

A procedure is described for the determination of the uranium content of sea water. The uranium is first separated and concentrated from 4 liters of sea water by solvent extraction with di-(2-ethylhexyl)-phosphoric acid in carbon tetrachloride. A further purification of the uranium is carried out by the extraction of uranyl nitrate into ethyl acetate, and the uranium concentration is found by pulse polarography using the peak from a perchloric acid-tartrate supporting electrolyte. U-237 is employed as a radioactive tracer to measure the percentage recovery of uranium in the chemical separation processes. The value obtained for English Channel water is 3.3 ± 0.08 μg of u/l. (auth)

16922 THE POLAROGRAPHIC BEHAVIOR OF CERIUM(IV) AND CERIUM(IV)−CERIUM(III) SYSTEM IN SULPHURIC MEDIA. A DIRECT DETERMINATION OF CERIUM(IV). Pier Giorgio Desideri (Univ. of Florence). J. Electroanal. Chem., 2: 39-45(Jan.-Feb. 1961).

The Ce(IV) reduction in sulfuric media on a bubbling platinum electrode was investigated. The influence on the ceric ion behavior of H_2SO_4 ionic activity, the presence of catalysts, as well as temperature change was observed. The conditions under which the redox Ce(IV)−Ce(III) system becomes reversible in sulfuric media are defined and the influence of acidity, catalysts, and temperature is studied. Finally, a polarographic direct determination of Ce(IV) is described. (auth)

16923 ELECTRICAL-RESISTIVITY METER MONITORS OXYGEN CONTENT OF LIQUID METALS. L. R. Blake and A. R. Eames (United Kingdom Atomic Energy Authority, Caithness, Scotland). Nucleonics, 19: No. 5, 66; 68; 70; 72(May 1961).

A device is described for continuously detecting and measuring gaseous impurities, mainly O but including C and H, entrained in liquid metals (Na, NaK, etc.). The meter is sensitive to impurity changes of 1 ppm, and is insensitive to temperature changes. It operates on the principle that impurities increase the resistivity of the metal. Such an instrument is used in the Dounreay Fast Reactor.

16924 RAPID DETECTION OF URANIUM TRACES IN THE PRESENCE OF IRON AND COPPER. Kazimierz Majchrzak (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 886(1960). (In English)

A method for the detection of uranium in the presence of copper and iron is described. The uranyl sulfate complex is adsorbed on a strongly basic anion exchanger on which the color reaction of the uranyl ion with potassium ferrocyanide is obtained. The sensitivity of the method is good as low as 2 to 2.5μg/ml. (N.W.R.)

16925 ABSOLUTE METHODS OF MEASURING ISOTOPE ACTIVITY. Tadeusz Radoszewski (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 887(1960). (In Polish)

Absolute measurements of beta and gamma activity of various radioisotopes are described. (R.V.J.)

16926 SENSITIVE PHOTOMETRIC DETERMINATION OF THORIUM WITH ARSENAZO III. V. I. Kuznetsov and S. B. Savvin. Radiokhimiya, 3: No. 1, 79-86(1961). (In Russian)

A photometric method capable of determining 0.05-γ of Th with arsenazo III is suggested. The presence of 10- to 100-fold quantities of various elements, in addition to Zr and U and any amounts of sulfates, phosphates, and other complexing substances, do not interfere. An extraction-photometric variation for Th determination is developed. Concentration of Th by co-precipitation as Th−arsenazo III complex on colorless precipitant, formed by diphenyl guanidine salt−anthracene−α-sulfo acid is described. (R.V.J.)

16927 NUCLEAR METHOD FOR ANALYSIS OF SULFUR IN HYDROCARBONS. George G. Manov (National Aeronautics and Space Administration, Washington, D. C.) and L. J. Beaufait. p.55-65 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

The use of radioisotopes as a basis for radiophysical instrumental methods of analysis can be exemplified by the following: Iron-55 emits a K-capture electron from the nucleus whose radiation can be absorbed by a sulfur atom regardless of its chemical combination. A practical procedure is described for the measurement of sulfur in all forms by using an uncalibrated source of iron-55, a sample holder, a suitable absorption cell, and an appropriate detecting instrument. The method for analytical determination of sulfur in hydrocarbons is very fast compared to the standard lamp or bomb used in present

methods. The equipment was built and operated, and a method was prepared for proposal. (auth)

16928 THE DETERMINATION OF GASES IN METALS. Report of a Symposium organized by The Society for Analytical Chemistry in Conjunction with The Iron and Steel Institute, The Institute of Metals. Special Report No. 68. London, The Iron and Steel Institute, 1960. 314p.

The determination of hydrogen, nitrogen, and oxygen in iron or one of a small selection of non-ferrous metals by vacuum-fusion analysis, spectroscopy, radioactivation and isotope-dilution analysis, carrier-gas techniques, x-ray diffraction and x-ray fluorescence analysis, and measurements of internal friction are described. There are 13 articles on the determination of gases in metals. (N.W.R.)

16929 MONITORING SYSTEM FOR DETERMINING THE HEAVY WATER CONTENT OF AIR. (to Atomic Energy of Canada, Ltd.). British Patent 865,433. Apr. 19, 1961.

A monitoring system is designed for rapidly determining the heavy water (D_2O and T_2O) content of air. The system comprises a compressor, a heat exchanger for cooling the compressed air, a separator for separating condensed water from the air, and an infrared analyzer. The D_2 content of the condensate is estimated by measuring its infrared absorption around 4 μ, and the T_2 content in turn is estimated from the T/D ratio. The detector gas preferably is ND_3. The system is capable of detecting heavy water in amounts as small as 2 g in 10^6 g H_2O. (D.L.C.)

General Inorganic and Physical Chemistry

16930 (OOR-2254:1) STRUCTURE ANALYSIS OF COMPLEX COMPOUNDS WITH EMPHASIS ON EIGHT-COORDINATION TYPES. Final Report, February 1, 1959-January 31, 1961. J. L. Hoard (Cornell Univ., Ithaca, N. Y.). Contract DA-30-069-ORD-2526. 16p.

All x ray diffraction studies were conducted utilizing spectrometrically-measured (MoKα) three-dimensional intensity data from single crystals. An efficient procedure employing the convergent beam technique for counter measurement of the several thousands of {hkl} intensities given by a typical crystal, and the development (for the Burroughs 220) of computational programs to handle the data are described. Intensity measurements are being used as follows: in the almost completed structure determination of zirconium(IV) acetylacetonate; for structure analysis of the tetrakis-oxalato complexes of Zr(IV) and Hf(IV); for accurate refinement of the classic $K_4(Mo(CN)_8)\cdot 2H_2O$ structure; and for the structure determination of an EDTA complex of ferric iron. The significance of the zirconium acetylacetonate and other studies of discrete eight-coordination complexes is discussed. (auth)

16931 SYNTHESIS AND X-RAY DATA OF MAGNESIUM URANYL SULPHATE: $MgUO_2(SO_4)_2nH_2O$. Neysa Soares Rocha (Departamento Nacional da Produção Mineral, Rio de Janeiro). Anais acad. brasil. cienc., 32: 341-3 (Dec. 31, 1960). (In English)

The synthesis of magnesium uranyl sulfate, $MgUO_2(SO_4)_2nH_2O$, was carried out using magnesium sulfate and uranyl sulfate solutions. The compound obtained belongs to the orthorhombic system; its space group is Pbmm; its unit cell dimensions, $a_0 = 8.289$ A, $b_0 = 11.34$ A, $c_0 = 6.40$ A. Refractive indices are $N_x = 1.558$, $N_z = 1.587$, $N_y = 1.573$ calculated by $\cos^2 V = \left(\frac{\beta-\alpha}{\gamma-\alpha}\right)$; 2V up to 90°, B = 0.029. (auth)

16932 ON THE APPLICATION OF PLUTONIUM IN INVESTIGATIONS OF ELECTRIC POTENTIALS ON FREE SURFACES. B. Kamieński, J. Mikulski, J. Pawełek, and I. Stroński (Inst. of Physical Chemistry, Academy of Sciences, Krakow and Inst. of Nuclear Physics, Academy of Sciences, Krakow). Bull. acad. polon. sci. Ser. sci. chim., 8: 685-90(1960). (In English)

The electric phenomena appearing on the free surface as potentials are measured by a radioactive method using plutonium. The method consisted of covering a brass electrode (diameter 10mm) with a plutonium layer (Pu^{239} $T^1/_2 = 2.4 \times 10^4$ years, $E\alpha = 5.2$ Mev) in the form of a compound with alizarin and tenoilotrifluoracetone. The layer is covered with a very thin collodion film. The intensity of the α particles is measured with a scintillation counter with the count having a ±5% accuracy. The potential of the electrode is measured at best no further than 3mm from the free surface and caution is necessary to prevent the layer from wetting by the solution, and to avoid contamination. (N.W.R.)

16933 ON THE STRUCTURE OF THE SURFACE LAYER OF MOLTEN NIOBATES. A. I. Manakov, O. A. Esin, and B. M. Lepinskikh (Inst. of Metallurgy, Ural Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 644-6(Jan. 21, 1961). (In Russian)

Changes in surface tension (σ) and surface potential (ϵ_s) were studied for $Cs_2O - Nb_2O_5$, $K_2O - Nb_2O_5$, and $CaO - Nb_2O_5$ systems at 1500°C. The data show that σ and $\Delta\epsilon$ drop sharply with additions of K_2O and Cs_2O up to 10 mole % and slowly decrease with the increase of Me_2O. With the admixture of CaO, the surface tension increases while $\Delta\epsilon$ does not change. Such behavior attests to the capillary activity of Cs^+ and K^+ cations, in contrast to Ca^{2+}. (R.V.J.)

16934 REACTIONS OF SULFUR TETRAFLUORIDE WITH OXIDES, OXYFLUORIDES, AND FLUORIDES OF URANIUM AND PLUTONIUM. Carl E. Johnson, Jack Fischer, and Martin J. Steindler (Argonne National Lab., Ill.). J. Am. Chem. Soc., 83: 1620-2(Apr. 5, 1961).

Some quantitative and qualitative observations concerning the reaction of sulfur tetrafluoride with various fluorides, oxyfluorides, and oxides of uranium and plutonium are presented. The reaction of sulfur tetrafluoride with plutonium hexafluoride in which plutonium hexafluoride is reduced to plutonium tetrafluoride is reported. (auth)

16935 DETONATION PROPERTIES OF HEAVY KNALLGAS, $2D_2 + O_2$. Leonard B. Alder, James A. Luker, and Edward A. Ryan (Syracuse Univ., N. Y.). J. Chem. Eng. Data, 6: 256-60(Apr. 1961).

Stable detonation velocities in heavy knallgas at 25°C agree closely with those predicted by Chapman-Jouguet detonation theory over an initial pressure range of 1 to 15 atm. The slight deviations noted are assumably due to, at low pressure, energy losses to the detonation tube. At elevated pressure, deviations presumably relate to inadequate ideal gas assumption in theoretical calculation, as suggested by Gealer and Churchill. Similar behavior is noted for knallgas. Stable detonation in heavy knallgas at 25°C is subideal at low pressure (less than 2 to 3 atm). Conclusion is based primarily on the relative agreement with theory of both heavy knallgas and knallgas reflected detonation pressures. This fact is not evident from the detonation velocity agreement. Pressure agreement is, apparently, a more effective indication of detonation ideality. Deviation is probably due in largest extent to a low chemical reaction rate in heavy knallgas detonation. (auth)

16936 A. C. POLAROGRAPHIC INVESTIGATION OF DISMUTATION. B. Breyer, J. R. Beevers, and H. H.

Bauer (Univ. of Sydney). J. Electroanal. Chem., 2: 60-5 (Jan.-Feb. 1961). (In English)

The dismutation reaction of the U(V) ion is studied by a-c polarography; various supporting electrolytes at different acid concentrations were used. An initial increase in the height of both a-c waves may be due to suppression of hydrolysis of the electroactive species. The first wave decreases at higher acid concentrations due to dismutation; relative values for the equilibrium constant of the dismutation process in different electrolytes are calculated, and are in agreement with values reported from d-c polarographic studies. The decrease in height of the second a-c wave at high acid concentrations seems due to changes in the structure of the electrical double-layer. (auth)

16937 A POLAROGRAPHIC AND SPECTROPHOTOMETRIC INVESTIGATION OF RHODIUM(III) BROMOCOMPLEXES. Danilo Cozzi and Fracesco Pantani (University, Pisa, Italy and Universita, Florence). J. Electroanal. Chem., 2: 72-9(Jan.-Feb. 1961). (In English)

In bromide solutions and in the presence of 0.03% gelatin, Rh^{3+} yields well-developed polarographic waves. The process is a practically reversible three-electron reduction. Several bromocomplexes appear to be in solution at the same time when the pH is lower than 3. Two maxima are observed in the absorption spectrum. Stability constants of the complexed forms were computed and resolution of the spectra was achieved. The results were confirmed by electrophoresis and anion-exchange resins. (auth)

16938 THE RELATIVE STABILITIES OF OXIDATION STATES OF TRANSITIONAL METALS. George W. Watt (Univ. of Texas, Austin). J. Electrochem. Soc., 108: 423-7(May 1961).

Conditions favorable to the formation of metals of the 3, 4, and 5d transitional series in all of their possible oxidation states are summarized. Certain broad generalizations are made with respect to factors possibly responsible for the relative stabilities of the various states; particular emphasis is placed on the character of the metal-ligand bond. (auth)

16939 LIGHT SCATTERING BEHAVIOUR OF THORIUM PHOSPHATE GEL-FORMING SYSTEM. U. M. Purao and D. M. Desai (Inst. of Science, Bombay and Gujarat Coll., Ahmedabad, India). J. Indian Chem. Soc., 38: 11-14(Jan. 1961). (In English)

The changes in depolarization values and in intensity of transversely scattered light of thorium phosphate gels, prepared by diluting acid solutions of thorium phosphate, are investigated. The results show that the particles grow in size owing to agglomeration. This study also reveals that the particles in the set gels are very nearly spherical in shape. The intensity values show a gradual change initially; thereafter it attains a steady value. The dissymmetry : ratio I^0_{45}/I^0_{135} fails to provide true indication of probable shape of the particles in this system. (auth)

16940 A STUDY ON COMPLEX FORMATION OF BERYLLIUM WITH SALICYLIC AND SULPHOSALICYLIC ACIDS. Rebati Charan Das and S. Aditya (Mayurbhanj Chemical Lab., Ravenshaw Coll., Cuttack-3, India). J. Indian Chem. Soc., 38: 19-22(Jan. 1961). (In English)

Beryllium perchlorate (Be^{2+}) forms a colorless complex with salicylic acid as well as with sulfosalicylic acid. The nature of these complexes is studied by ultraviolet spectrophotometry. The absorption spectra at different pH's suggest that the complex formation increases with an increase in pH. Composition of these complexes is studied at pH 4.5 by Job's method of continued variation. The molecular ratio of Be^{2+} to the ligand in both the complexes is 1 : 1. Stability constants are determined at ionic strengths 0.02, 0.05, 0.1, and 0.2M for the Be^{2+}-salicylic acid complex as well as for the Be^{2+}-sulfosalicylic acid complex. Thermodynamic stability constants are found by extrapolation and are 1.66×10^4 and 2.24×10^4 for salicylic acid and sulfosalicylic acid complexes respectively; the values of $-\Delta F$'s are 5830 and 6010 cals respectively. (auth)

16941 PHASE EQUILIBRIA IN THE SYSTEM CsF–ThF_4. R. E. Thoma and T. S. Carlton (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 17: 88-97(Apr. 1961). (In English)

The phase equilibrium diagram of the condensed system CsF–ThF_4 is constructed from a combination of results obtained using both thermal analysis and quenching techniques. Phase identification was accomplished by petrographic and x-ray diffraction analysis. In the system CsF–ThF_4 seven compounds were identified. Three of these, $3CsF \cdot ThF_4$, $2CsF \cdot ThF_4$, and $CsF \cdot ThF_4$, melt congruently at 980°, 869°, and 839°, respectively. The compounds $2CsF \cdot 3ThF_4$, $CsF \cdot 2ThF_4$, and $CsF \cdot 6ThF_4$ melt incongruently at 842°, 860°, and at 1010°, respectively. The compound $CsF \cdot 2ThF_4$ decomposes on cooling to $2CsF \cdot 3ThF_4$ and $CsF \cdot 3ThF_4$ at 813°. The compound $CsF \cdot 3ThF_4$ has a subsolidus upper limit of stability at 830°. Comparisons of the phase equilibria in the system CsF–ThF_4 are made with those of other binary systems of ThF_4 and alkali fluorides. (auth)

16942 NIOBDIHYDRID, NbH_2. G. Brauer and Horst Muller (Universitat, Freiburg i.B.). J. Inorg. & Nuclear Chem., 17: 102-7(Apr. 1961). (In German)

Niobium dihydride was prepared in a pure form by cathodic hydrogenation of niobium metal. Its homogeneity range extends from $NbH_{2.00}$ to ca. $NbH_{2.07}$. It crystallizes with the fluorite structure and has a lattice constant of 4.563 A. Niobium dihydride is unstable and decomposes into β-NbH and hydrogen. (auth)

16943 URANYL BROMIDES OBTAINED FROM AQUEOUS SOLUTION. Sigfred Peterson (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 17: 135-7(Apr. 1961). (In English)

Uranyl bromide can be crystallized from acid solution as the very hygroscopic trihydrate. Part of the water can be removed at 60°C without decomposition, but irreversible decomposition takes place at 115°C. Its saturated solution is 6.5 M, viscous, very dark red, and of density 3.36 g/ml. Recrystallization from ether or isopropanol yields organic solvate-hydrates. The basic bromide, $UO_2(OH)Br \cdot 2H_2O$ was crystallized from acid-deficient uranyl bromide solutions. It forms stable dilute aqueous solutions, but its concentrated solutions deposit hydrated uranium trioxide. (auth)

16944 ALKALINE OXIDATION OF AMERICIUM; PREPARATION AND REACTIONS OF Am(IV) HYDROXIDE. R. A. Penneman, J. S. Coleman, and T. K. Keenan (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 17: 138-45(Apr. 1961). (In English)

A pink slurry of $Am(OH)_3$ is converted quantitatively into the black hydroxide (or hydrous oxide) of tetravalent americium by hypochlorite oxidation in dilute base. This material dissolves in nitric of perchloric acid and disproportionates according to the equation: 2Am4+ = Am5+ + Am3+. It dissolves in sulfuric acid giving Am6+ and Am3+, with a minimum of half of the Am5+ produced from the simple disproportionation of Am4+ being consumed by a consecutive reaction: Am4+ + Am5+ = Am6+ + Am3+. Revision from +0.4 to at least −0.5 v is suggested for the value of the standard potential of the $Am(OH)_3 - Am(OH)_4$ couple. Oxidation of $Am(OH)_3$ past $Am(OH)_4$ is observed with both ozone

and peroxydisulfate. Details are given for a new and convenient method for producing AmO_2^{2+} in dilute acid solution based on the ozone oxidation of $Am(OH)_3$. Ozone oxidizes $Am(OH)_3$ in 0.1 M NaOH to a soluble yellow complex of Am6+. (auth)

16945 PREPARATION AND PROPERTIES OF LANTHANUM AND CERIUM DIIODIDES. J. D. Corbett, L. F. Druding, and C. B. Lindahl (Ames Lab., Ames, Iowa). J. Inorg. & Nuclear Chem., 17: 176-7(Apr. 1961). (In English) (IS-194)

Reduction of LaI_3, m p 778°, proceeds substantially quantitatively to LaI_2, $LaI_{2.04\pm0.03}$ with excess metal at 790 to 815°; the diiodide melts slightly incongruently at 820°. Similarly, CeI_3, m p 766°, is reduced to CeI_2(<2.06 I/Ce obs), which at 799 ± 3° is in equilibrium with liquid metal and a melt of composition $CeI_{2.09}$. Both exhibit an intermediate compound identified as $CeI_{2.4}$, peritectic 731°. The diiodides are isomorphous and distinctly different from the other lanthanon(II) iodides in their high melting points and in their general metallic appearance, which shades from blue-black to bronze. The metal-like character is confirmed by their high conductivities. Qualitative susceptibility measurements indicate that LaI_2 is diamagnetic. These compounds probably do not contain M^{2+} ions but rather the normal tripositive ions together with an equal number of electrons in essentially metallic bonding with the cations, for example, $M^{3+}e^-(I^-)_2$. (N.W.R.)

16946 ABSORPTION SPECTRA OF SOLID UCl_4 AND $UOCl_2$. R. E. Ewing (General Electric Co., Richland, Wash.). J. Inorg. & Nuclear Chem., 17: 177-8(Apr. 1961). (In English) (HW-SA-1976)

The absorption spectra of anhydrous UCl_4 and $UOCl_2$ were determined by preparing a mull of the solids in petrolatum. The absorption spectra for U(IV) in concentrated hydrochloric acid is used for comparison at the prominent bands 600 to 700 and 1000 to 1200 mμ. The qualitative data show some interesting differences between the two compounds. $UOCl_2$ solid shows a new band between 1250 and 1350 mμ and fine structure on the 1000 to 1200 mμ band which probably results from a vibrational mode of the uranium-oxygen bond. (N.W.R.)

16947 GROUND STATE OF THE FIRST SPECTRUM OF PLUTONIUM (Pu I), FROM AN ANALYSIS OF ITS ATOMIC SPECTRUM. L. Bovey (United Kingdom Atomic Energy Research Establishment, Harwell, Berks, Eng.) and S. Gerstenkorn. J. Opt. Soc. Am., 51: 522-5(May 1961).

Data from King furnace work and hyperfine-structure and Zeeman studies on the spectra of Pu I have resulted in the derivation of three levels of the ^7F term. It is suggested that this term arises from the ground state electronic configuration $5f^6\ 7s^2$ and that these levels are at 0.0 cm^{-1} ($^7F_0$), 2203.6 cm^{-1} ($^7F_1$), and 4299.6 cm^{-1} ($^7F_2$). (auth)

16948 A THERMODYNAMIC CALCULATION OF SELECTIVITY COEFFICIENTS FOR STRONG-BASE ANION EXCHANGERS. G. E. Boyd, S. Lindenbaum, and G. E. Myers (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 65: 577-86(Apr. 1961).

A computation of the equilibrium selectivity coefficients for the exchange of bromide with chloride, iodide, or fluoride ions present in dilute aqueous solutions was performed for a series of cross-linked strong-base anion exchangers (polystyrene quaternary ammonium type) using the Gibbs-Donnan equation. Swelling pressures, P, and activity coefficient ratios, log $(\gamma_{X^-}/\gamma_{Br^-})r$, were evaluated from weight swelling measurements conducted in isopiestic vapor pressure experiments on virtually uncross-linked and on cross-linked exchangers. Partial molar volume differences, $(\bar{v}_{X^-} - \bar{v}_{Br^-})$, needed for the swelling free energy estimate were derived from density measurements on a weakly cross-linked exchanger. The calculated selectivity coefficients were in satisfactory agreement with independently measured experimental values except with the most highly cross-linked exchangers. When the values for the latter were corrected for their lower exchange capacities good agreement apparently was obtained. The thermodynamic treatment reported has led to the important generalization that, at constant temperature in the absence of specific interactions in the aqueous electrolyte phase, the selectivity coefficient, D_1^2, is a function solely of the weight swelling of the exchanger; whatever changes the swelling, be it the exchanger cross-linking, ionic composition or external electrolyte concentration, also will change D_1^2 in a manner that may be estimated from the Gibbs-Donnan equation. (auth)

16949 VOLTAMMETRY IN LIQUID SULFUR DIOXIDE. [PART] I. TECHNIQUE AND THEORETICAL PROBLEMS. Philip J. Elving, Joseph M. Markowitz, and Isadore Rosenthal (Univ. of Michigan, Ann Arbor and Pennsylvania State Univ., University Park). J. Phys. Chem., 65: 680-6(Apr. 1961).

The feasibility of voltammetry and polarography in solutions of a totally non-protonic solvent, sulfur dioxide, is investigated. Apparatus, procedures, and orientative work with various inorganic and organic solutes are described for two indicating electrodes, the dropping mercury electrode and the stationary cylindrical platinum electrode, and two reference electrodes, the mercury calomel pool and the silver–silver chloride electrode. The specific methodological findings are discussed critically, as are the theoretical aspects and practical effects for the general practice of voltammetry of the nonexistence of a suitable background electrolyte, the possibility of reference electrode polarization, and the presence of a characteristic high solution resistance. (auth)

16950 VOLTAMMETRY IN LIQUID SULFUR DIOXIDE. [PART] II. BEHAVIOR OF TRIPHENYLCHLOROMETHANE. REDUCTION OF THE TRIPHENYLMETHYL FREE RADICAL. Philip J. Elving and Joseph M. Markowitz (Univ. of Michigan, Ann Arbor). J. Phys. Chem., 65: 686-90(Apr. 1961).

The voltammetric and polarographic behavior of triphenylchloromethane in liquid sulfur dioxide is investigated, using the stationary cylindrical platinum electrode and the dropping mercury electrode; results with the latter are unsatisfactory due to reaction of mercury with the solute. Triphenylchloromethane gives one cathodic wave and two anodic waves, the more positive of the latter two being larger. The cathodic wave represents the reduction of triphenylmethyl cation to triphenylmethyl. The larger anodic wave is likely due to oxidation of the undissociated solute to the perchloride. No definite assignment can yet be made for the less prominent anodic wave. The fit of the data to Nicholson's equation for the cylindrical platinum electrode and the effect of high solution resistance on such data are discussed. (auth)

16951 DISSOCIATION OF MOLYBDENUM(V) CHLORIDE IN CARBON TETRACHLORIDE SOLUTION. Irving M. Pearson and Clifford S. Garner (Univ. of California, Los Angeles). J. Phys. Chem., 65: 690-2(Apr. 1961).

Observations on solubility and dissociation of $MoCl_5$ in CCl_4 solution, as well as on the behavior of $MoCl_5$ in vacuum distillation and the removal of oxychloride contaminants

from $MoCl_5$, are reported. The experiments show that Cl_2 is released when $MoCl_5$ dissolves in CCl_4 at 2 to 26°C, but because of the sensitivity of $MoCl_5$ to moisture and its low solubility in CCl_4, the nature of the Mo species formed in the dissociation is not established. The data indicate that the dissociation may be by the path: $2MoCl_5(soln) \rightleftharpoons 2MoCl_4(soln) + Cl_2(soln)$, where $Cl_2(soln) \rightleftharpoons Cl_2(g)$. The distillation data suggest that the dissociation is fairly rapid. (N.W.R.)

16952 ROTATION AND MOLECULAR DISTORTION IN THE CONDENSED PHASES OF HEXAFLUORIDE MOLECULES. B. Weinstock (Argonne National Lab., Ill.). Phys. and Chem. Solids, 18: 86-9(Jan. 1961).

The symmetrical structure found for these molecules in the vapor phase is distorted in the condensed phases. This octahedron structural alteration has a significant effect on the equilibrium thermodynamic properties. The metal to fluorine distances for six molecules are presented, and the entropy of fusion and triple point temperature is shown for UF_6, NpF_6, and PuF_6. (N.W.R.)

16953 THE STRUCTURE OF TRIHYDRATE AND DIHYDRATE URANIUM NITRATE CRYSTALS. V. M. Vdovenko, E. V. Stroganov, and A. P. Sokolov. Radiokhimiya, 3: No. 1, 19-23(1961). (In Russian)

A method is developed for taking x-ray diffraction pictures of hygroscopic monocrystals. X-ray diffraction data on $UO_2(NO_3)_2 \cdot 3H_2O$ and $UO_2(NO_3)_2 \cdot 2H_2O$ crystals are analyzed. (R.V.J.)

16954 MICROQUANTITIES OF RADIOELEMENTS IN SOLUTIONS. XV. POLONIUM SORPTION BY ION EXCHANGE RESINS. I. E. Starik and N. I. Amplelogova. Radiokhimiya, 3: No. 1, 37-44(1961). (In Russian)

Polonium sorption on various types of ions in 0.1 to 12 M hydrochloric and nitric acid solutions and the sign of the complexes formed are studied. Sorption by H-form cation exchange resin (KU-2) and two types of anion resin (PE-9, mean base and AB-17, strong base) in Cl and NO_3^- forms was analyzed, as well as sorption on styrene and divinylbenzene polymers without exchange groups. The sorption of polonium by AB-17, KU-2, and PE-9 is not a purely ionic process. A considerable reaction of polonium with basic organic resin was observed in weak acid media. The anion sorption of polonium is high and mostly irreversible in all HCl concentrations. A shift in the equilibrium between cations and anions was observed in sorption by ionites in weakly acid media. Negatively charged polonium complexes prevail in 0.1 to 9 M hydrochloric acid solutions. The appearance of unchanged complexes is possible in 9 to 11 M HCl. Anion complexes prevail in nitric acid solutions at 2.5 to 10 M; cation polonium is present in weakly acid media (0.1 to 2.5 M) and concentrated nitric acid (over 10 M). (R.V.J.)

16955 BEHAVIOR OF MICROQUANTITIES OF RADIOELEMENTS IN DILUTE SOLUTIONS. BEHAVIOR OF Am IN ION EXCHANGE. I. E. Starik and F. L. Ginzburg. Radiokhimiya, 3: No. 1, 45-51(1961). (In Russian)

The sorption of Am^{241} on ion exchange resins in nitric acid solutions (1 to 18 M) was studied. It was found that Am^{3+} is predominant in the solutions up to 1 M. With pH >4 the positive charge is reduced due to hydrolysis. Anion sorption of colloidal americium reaches 80%, however, cation sorption of colloidal americium does not occur. Electromigration and sorption in nitric acid solutions indicate the formation of positively charged complexes in 1 to 4 M solutions. Neutral americium complexes are predominant in 4 to 16 M solutions. (R.V.J.)

16956 COMPLEX FORMATIONS OF YTTRIUM. IV. OXALATE COMPLEXES. M. G. Panova, V. I. Levin, and N. E. Brezhneva. Radiokhimiya, 3: No. 1, 52-61(1961). (In Russian)

The solubilities of Ce^{4+} and Y^{4+} oxalates were determined in relation to oxalate ion activity. The stability constants of the complexes formed were evaluated. (R.V.J.)

16957 PREPARATION OF PLUTONIUM TARGETS FOR CYCLOTRON IRRADIATION BY MULTICHARGED IONS. K. A. Gavrilov, G. F. Myasoedov, and G. I. Khlebnikov. Radiokhimiya, 3: No. 1, 62-7(1961). (In Russian)

Ultra-minute quantities of Fe, Tl, Hg, Bi, and Pb were separated from Pu. Pu^{239}, Pu^{240}, Pu^{241}, and Pu^{242}, containing Pb < 0.01 μg per 100 μg of Pu, were prepared; the rest of the admixtures were below the activation sensitivity. The purified Pu was subjected to electrolytic treatment, concentration by evaporation with tetraethylene, and used in preparing targets for producing element 102. (R.V.J.)

16958 THE KINETIC SOLVENT-ISOTOPE EFFECT ON ACID CATALYTIC REACTIONS WITH SLOW HYDROGEN ION TRANSFER. A. V. Willi (Universität, Bern). Z. Naturforsch., 16a: 162-9(Feb. 1961). (In German)

The kinetic deuterium isotope effect on the reaction H_3O^+ + substrate (S) → product was calculated approximately for various models of the transition states which are all linear, with the help of partial functions. The influence of the tunnel effect was also considered. As an upper range for the isotope effect, $k_H/k_D = 1.6$ at 25°C was obtained. In four out of six well known examples the experimental values lie between 1.7 and 4.3. In the two remaining cases they are in the vicinity of 1.0. The prerequisites for the validity of the model serving as basis for the calculation are discussed. (tr-auth)

16959 ANODIC SOLUTION RATE OF NICKEL IN NITRIC ACID. A. I. Falicheva and R. I. Tsyfanova (Kirov Urals Polytechnic Inst., Sverdlovsk). Zhur. Fiz. Khim., 35: 350-4(Feb. 1961). (In Russian)

The effect of nitric acid concentration, anodic current density, and temperature on the rate of solution of nickel in nitric acid was investigated. Maximum solution rate was found to take place in 8.17 N nitric acid at 40°C and d_A = 750 amp/cm^2. The influence of the above factors on the amount of ammonium salts formed during the anodic solution of nickel in nitric acid is ascertained. Polarization curves were obtained during the solution process. It is found that the polarization curves for 3.17 and 3.78 N nitric acid consist of two branches, the first corresponding to ionization of Ni^0 to Ni^{2+} and the second (following a current drop and potential jump) to oxygen evolution and the formation of higher valency nickel ions, evidently Ni^{3+}. (tr-auth)

16960 DIFFUSION OF ELECTROLYTES AND THE POLAROGRAPHIC METHOD. DIFFUSION COEFFICIENTS OF THE URANYL ION IN AQUEOUS HCl SOLUTIONS OF VARIOUS CONCENTRATION. Ts'ai-shen Kao (Gao Tsai-shen) and Ya. P. Gokhshtein (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 404-6(Feb. 1961). (In Russian)

The diffusion coefficients of UO_2^{2+} in HCl of various concentrations were obtained by means of a microdiffraction method. The D values for the uranyl ion calculated with the aid of Hans' equation over the range 0.001 to 0.01 M HCl are in good agreement with the method. (tr-auth)

16961 PERMEABILITY TESTS FOR ORGANIC SHEET MATERIALS. Meyer Pobereskin (M & C Nuclear, Inc.,

Attelboro, Mass.). p.100-3 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

A method is proposed for measuring permeability by a radiometric method. Advantages of this method are speed, accuracy, sensitivity, and wide range of measurement. In addition, the method lends itself readily to measurement of gas or vapor concentration in the organic sheet material and its surface evaporation rate. It may also be used to measure the permeability of coatings applied to a backing material. (N.W.R.)

Radiation Chemistry and Radiochemistry

16962 (AFCRL-TR-60-423) THE DETERMINATION OF IONIZATION AND DISSOCIATION POTENTIALS OF MOLECULES BY RADIATION WITH ELECTRONS. Final Report. D. C. Frost and C. A. McDowell (British Columbia. Univ., Vancouver). Oct. 1960. Contract AF19(604)-2275. 37p. (AD-247419).

The ionization and dissociation of molecules by electron impact using the retarding potential difference method (R.P.D.) to obtain monoenergetic electrons were studied. Preliminary studies on the photoionization of simple molecules were also carried out. The electron impact studies led to new information about the ionization potentials of molecules and the electron impact induced dissociation process. The molecules studied include O_2, the halogens HF, CS_2, N_2O, COS, CO_2, formaldehyde, acetaldehyde, H_2O, F_2O, and methyl cyanide. The photoionization studies were largely restricted to the NO and NH_3 molecules. (auth)

16963 (BMI-1511) A STUDY OF RADIATION-INDUCED CHANGES IN POLYMERS LEADING TO GRAFT COPOLYMERIZATION AS INFLUENCED BY STRUCTURAL FACTORS. Israel S. Ungar, John F. Kircher, William B. Gager, Francis A. Sliemers, Jr., and Robert I. Leininger (Battelle Memorial Inst., Columbus, Ohio). Apr. 3, 1961. Contract W-7405-eng-92. 28p.

The preparation, irradiation, and grafting of a number of polymethacrylates are described. A mechanism of radiation attack on the polymers is proposed. Free-radical measurements, the quantitative determination of the volatile products of irradiation, and chemical analysis of the grafted copolymer were used in establishing this mechanism. The data suggest that a major portion of total free-radical formation is accomplished by means of a whole or partial ester scission, the size and configuration of the hydrocarbon tail of the ester group influence the efficiency of site formation, site formation is accompanied, in some cases, by a scission of the polymer backbone, and the amount of grafted copolymer increases with increased free-radical concentration. (auth)

16964 (NAS-NS-3022) THE RADIOCHEMISTRY OF VANADIUM. J. L. Brownlee, Jr. (Michigan. Univ., Ann Arbor). Dec. 1960. 79p. "Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review of vanadium nuclear and chemical features of interest to the radiochemist is presented followed by discussions of sample dissolution, counting techniques, and a literature survey of radiochemical procedures. (J.R.D.)

16965 (NAS-NS-3030) THE RADIOCHEMISTRY OF SELENIUM. G. W. Leddicotte (Oak Ridge National Lab.). [1961]. 46p. "Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review of the nuclear and chemical features of selenium, a discussion of problems of sample dissolution and counting techniques, and a collection of radiochemical procedures for the element as found in the literature are presented. (94 references) (M.C.G.)

16966 (NYO-9106) A STUDY OF THE MECHANISM OF RADIATION INDUCED GELATIN IN MONOMER-POLYMER MIXTURES. Quarterly Summary Report, November 1, 1960 to January 30, 1961. (Radiation Applications Inc., Long Island City, N. Y.). 7p. Contract AT(30-1)-2554.

Polyvinyl chloride degrades quite badly under irradiation due to the ease of splitting out of HCl. The incorporation of polyfunctional monomers, however, was found to lower the radiation doses required for gelation below those which result in degradation. Thus, gelation of polyfunctional monomer-polyvinyl chloride mixtures was achieved quite readily. On irradiation, the behavior of polypropylene lies between that of polyethylene, which crosslinks readily with little main chain fracture, and polyisobutylene, in which main chain fracture is the main reaction. On "straight" irradiation, crosslinking only slightly exceeds degradation and therefore the dose to gel is very high. It was found that the radiation dose to gel can be drastically reduced via the use of polyfunctional monomers. Polyethylene, unlike polyvinyl chloride and polypropylene, crosslinks quite readily on irradiation. However, the dose requirements for gelation are high. It was found that the dose to gel may be lowered by the use of the various polyfunctional monomers. (auth)

16967 (RCC-R-111) EXPERIMENTS ON THE RELEASE OF IODINE-131 FROM IRRADIATED TELLURIUM DIOXIDE. J. S. Burgess, L. R. Parmenter, and E. J. Partington (United Kingdom Atomic Energy Authority. Research Group. Radiochemical Centre, Amersham, Bucks, England). Feb. 1961. 11p.

The rate of I^{131} release in oxygen from irradiated tellurium dioxide powder was studied over the temperature range from 400 to 700°C. The iodine was released rapidly at the higher temperatures during the first heating cycle when the powder sintered, but subsequent recycling at the same temperature gave a less efficient separation. An explanation for this behavior is offered based on the mechanisms of the diffusion and sintering processes. (auth)

16968 (RRL-57) QUARTERLY REPORT ON RADIATION RESEARCH, JANUARY 1, 1961–MARCH 31, 1961. (Mellon Inst. Radiation Research Labs., Pittsburgh). Apr. 6, 1961. Contract AT(30-1)-2310. 15p.

A survey of the yields of methyl radicals from some 25 different aliphatic hydrocarbons was completed. Competition studies indicated little or no energy barrier to the reaction of radicals with iodine. Irradiation of liquid cyclohexane samples to which up to 1.0% isobutene was added resulted in the formation of isobutane and several new products in the C_{10} region including tert-butylcyclohexane. Ethylene was utilized as a scavenger for intermediates in the radiolysis of cyclopentane. Studies by electron paramagnetic resonance of the hydrocarbon radicals at steady state during radiolysis of liquids are being continued. The initial stages of the chlorine atom induced polymerization of acetylene were investigated. The formation of benzene in the radiolysis of acetylene was studied. The investigation of the radiolysis of cis-1,2,-dichloroethylene was continued. Studies of the use of tritium iodide as a radical scavenger were facilitated by the addition of a flow proportional counter to the exit side of the chromatographic

equipment. The hydrogen formed in the irradiation of mixtures of benzene and perdeutero benzene with 30-Mev helium ions was found to have the same isotopic composition as that previously reported by Gorden and Burton for fast electron irradiations. (M.C.G.)

16969 (TID-11815) RESEARCH IN NUCLEAR AND RADIOCHEMISTRY. Progress Report for Year Ending January 31, 1961. T. T. Sugihara (Clark Univ., Worcester, Mass.). Contract AT(30-1)-1930. 79p.

Products in Alpha-induced Reactions. The recoil ranges of cobalt nuclides formed in alpha-irradiated manganese were measured for alpha energies of 19, 23, and 27 Mev and normalized to that of Co^{57}. Product recoil ranges are also reported for the reactions $Ni^{58}(\alpha,\alpha p)$ and $(\alpha,\alpha n)$, $Ni^{60}(\alpha,2n)$, $Cu^{65}(\alpha,2n)$, $Cu^{63}(\alpha,2n)$ and (α,pn), and $Cu^{65}(\alpha,\alpha n)$ at alpha energies of 25 to 30 Mev; Zn^{62} was found to have a shorter average range than Ni^{57} and Co^{57}. The results are discussed with reference to range ratios, compound-nucleus theory, and evaporation effects. Products in Bombardment of Niobium. Isomeric ratios were measured for the $(\alpha,2p)$, (α,n), and $(\alpha,2n)$ reactions of Nb^{93}. Half Life of In^{117g}. Cadmium metal was irradiated by 14- and 5-Mev deuterons and subjected to radiochemical separation. Gamma spectrum decay analysis gave a half life of In^{117m} as 1.93 ± 0.04 hr and of In^{117g} as 38.0 ± 0.5 min, in agreement with Nuclear Data Sheets but in disagreement with McGinnis' 1.1-hr value for the half life of In^{117g}. Studies of the $In^{115}(\alpha,2p)In^{117}$ Reaction. Isomeric ratios were measured for the $In^{115}(\alpha,2p)$ reaction at alpha energies of 23 to 27 Mev. The cross section for In^{117g} is ~0.5 mb at 27 Mev and decreases somewhat with decreasing energy, while that for In^{117m} is ~0.15 mb at 27 Mev and nearly independent of energy. The results indicate that a compound-nucleus mechanism is not involved. Recoil Studies of Uranium Fission Fragments. Nuclear recoils from U^{238} fission induced by 150-Mev protons were studied, and calculated recoil parameters and kinetic energies are presented for Cu^{64}, Cu^{67}, Ga^{72}, Sr^{91}, Pd^{112}, Ag^{111}, Ag^{112}, Ag^{112} Ag^{113}, In^{117m}, Ba^{139}, and Ba^{140} together with momentum transferred and deposition energies. Some preliminary results for 45-Mev proton bombardments are discussed. Szilard-Chalmers Reactions in Metal Porphines. The Szilard-Chalmers reaction was investigated in tetraphenylporphines of Co, Ni, Cu, Zn, Pd, and Pt. The effects of various irradiation and extraction conditions and thermal annealing on the organic retentions were studied. There is no correlation between the retention values and the mass of the recoil atom, and variations in irradiation conditions have little influence on retention values for Pd, Cu, and Zn, while the results for Ni indicate it may be sensitive to radiation annealing. Large isotope effects were found in Zn and Pd; the Zn^{69}/Zn^{65} and Pd^{109}/Pd^{103} retention ratios are 2.8 and 1.5, respectively. Analytical Chemistry of Cesium and Rubidium. Thallium phosphotungstate was found to be an excellent ion exchanger for cesium and absorbs cesium and rubidium quantitatively from large volumes of sea water. Elution of cesium and rubidium from the ion exchanger was studied; a 0.4M HNO_3 solution containing 5×10^{-3}M $TlNO_3$ removes rubidium quantitatively and cesium not at all, while solutions of higher $TlNO_3$ concentrations remove cesium as well. Analytical Radiochemistry of Actinium. A chemical separation method for separating actinium from lanthanum is outlined which involves chromatographic and counting steps. Ion Exchange Studies of Alkaline Earths. Distribution coefficients between Dowex A-1 resin and solution were determined for Mg, Ca, Sr, and Ra as a function of pH, and the order of affinity was found to be Ra > Ca > Sr > Mg. Separation of Ca and Sr in a Dowex A-1 column was studied, and it is concluded that the separation is not satisfactory due to the large band widths. (D.L.C.)

16970 (TID-12499) THE CHEMISTRY AND NUCLEAR CHEMISTRY OF THE HEAVY ELEMENTS. Progress Report No. 6, March 1960 to March 1961. J. W. Cobble, ed. (Purdue Univ., Lafayette, Ind.). Mar. 1961. Contract AT(11-1)-347. 164p.

Research on the independent fission yields of U^{233}, U^{235}, and U^{238} induced by 20- to 40-Mev He ions was completed. The results appear in a publication, a reprint of which is included along with published results of U^{233} and U^{238} fission cross section studies. In other work, fission studies of Np^{237} with alpha particles at 20 to 40 Mev are being completed. Mass yield curves were prepared in this program, and data for total fission cross section curves were collected. Data on the independent yield cross sections for Br^{82}, La^{140}, and Pr^{142} were obtained and are tabulated for comparison with data obtained in other research and with theoretical values. Data from other fission studies on Th^{132}, Au, and Re are discussed. Studies of decay schemes on Pd^{109}, Ru^{105}, and the branching ratio of Rb^{86} are reported. Investigation of plastic hollow-well beta scintillation phosphors for spectroscopic work is reported. Aspects considered include variation of linearity and resolution with maximum energy and crystal size, the effects of sample backing, crystal behavior in presenting spectra so that the shapes of forbidden and allowed spectra are distinct, and the ability of crystals to resolve complex spectra. A reprint of a publication on the design of a sensitive thermistor microcalorimeter and on the heats of solution of Np, U, and UCl_4 is also included. (J.R.D.)

16971 (TID-12548) MECHANISM OF HIGH ENERGY RADIATION EFFECTS IN POLYMERS. Technical Report No. 6 Covering Period March 1, 1960 to April 1, 1961. Malcolm Dole (Northwestern Univ., Evanston, Ill.). Apr. 15, 1960. Contract AT(11-1)-89. 10p.

Hydrogen-Deuterium Exchange. Extensive exchange between D_2 gas and solid polyethylene occurred for 100 hr on warming up to room temperature after irradiation at liquid N_2 temperature. A kinetic treatment of the situation is presented. The kinetic equations for first-order free radical decay fitted the data best, but not perfectly, and the discrepancy indicates that the reactions $D\cdot + RD \rightarrow R\cdot + D_2$ and $H\cdot + RD \rightarrow R\cdot + HD$ are significant. It is postulated that the reactions $R\cdot + D_2 \rightarrow RD + D\cdot$ and $D\cdot + RH \rightarrow HD + R\cdot$ provide a mechanism for migration of free radical sites in solid polyethylene. Polypropylene Oxide. Radiation effects on racemic propylene oxide monomer were studied. No perceptible change in the viscosity was observed. The G value for total gas evolution was determined to be ~4, and ~¾ of the evolved gas could not be condensed at liquid N_2 temperatures. Intrinsic Viscosity of Irradiated Polymers. Equations are derived for relating the change in intrinsic viscosity to the dose received. (D.L.C.)

16972 (TID-12599) RADIATION STABILITY OF ORGANIC LIQUIDS. Semi-Annual Report No. 1, August 1, 1960—January 31, 1961. A. H. Samuel, R. S. Farrand, and W. E. Wilson (Stanford Research Inst., Menlo Park, Calif.). Jan. 31, 1961. For Oak Ridge National Lab. Contract AT(04-3)-115, Subcontract No. 2041. Project Agreement No. 25. 35p.

An experimental method was devised for the simultaneous irradiation and nitric acid equilibration of TBP—Amsco solutions. Solutions with three nominal nitric acid concentrations were irradiated with 1-Mev (nominal) electrons at three dose levels. Ceric dosimetry was used. Analytical

procedures for the determination of dibutyl phosphate (DBP), monobutyl phosphate (MBP), and phosphoric acid (H_3PO_4) were reexamined and revised, and some improvement was attained. Work on analytical methods continues. The chemical changes produced in the irradiated solutions are characterized by high G values (molecules created or destroyed per 100 electron-volt energy input) for the disappearance of nitric acid and very low G values for the formation of phosphoric acid. G(−HNO_3) was in the range 3.5 to 12.2; G(DBP) was in the range 1.0 to 6.9; G(MBP) was in the range < 0.01 to 0.4. G(−HNO_3) and G(DBP) tended to increase with increasing acid concentration and to decrease with increasing dose. Gas samples were analyzed by mass spectrometry and relative yields of gaseous radiolytic products obtained. Four potential protective agents were screened. Three showed no marked effect (CS_2, latex, $C_7H_7I + I_2$), while one(HBr) increased radiolytic yields. (auth)

16973 (AEC-tr-4554) APPLICATION OF THE EMANATION METHOD TO THE STUDY OF PROCESSES OCCURRING IN SOLIDS DURING THEIR HEATING. K. B. Zaborenko, A. M. Babeshkin, and V. A. Beevska. Translated from Radiokhimiya, 1: 336-45(1959). 10p.

Curves were obtained showing changes in emanation with temperature for $BaSO_4$ and $BaCO_3$ during heating. Temperature regions may be distinguished which correspond to changes occurring during the heating: evaporation of adsorbed water, disintegration of crystal lattice, sintering, polymorphic transformation, and decomposition. The regions found experimentally correspond to those found by other methods. The equipment permitted curves to be obtained which show the regions in question more distinctly, which makes it possible to detect changes not recorded previously when the emanation method was used. (auth)

16974 (CEA-tr-X-271) SORPTION DES ISOTOPES RADIOACTIFS SUR LES PRÉCIPITÉS. I. ENTRAINEMENT DU CÉSIUM DANS LES PRÉCIPITÉS D'HYDROXYDES ET DE POLYURANATE. (Sorption of Radioisotopes on Precipitates. I. Entrainment of Cesium in Precipitates of Hydroxides and Polyuranates). V. Kourim and J. Krtil. Translated into French from Chem. listy, 52: 1435-9(1958). 17p.

This paper was previously abstracted from the German language and appears in NSA, Vol. 13, abstract no. 13342.

16975 ON THE EFFECTIVE USE OF SPENT FUEL ELEMENTS AS SOURCES OF γ-RADIATION IN CHEMICAL RADIATION APPARATUS. A. Kh. Breger, Yu. S. Ryabukhin, and F. A. Makhlis (Karpov Inst. of Physics and Chemistry, USSR, and Moscow Inst. of Chemical Engineering). Doklady Akad. Nauk S.S.S.R., 136: 671-4 (Jan. 21, 1961). (In Russian)

Evaluations were made of the use of spent fuel elements in radiation chemistry. The mean specific γ power $\overline{P}$ emitted during a given time $\underline{K}$ was calculated: $P = \sum_{i=1}^{n} E_i^{\gamma}/K = \overline{P}(t_r, t_a, t_t, n)$, where $\sum_{i=1}^{n} E_i^{\gamma}$ is the γ energy emitted during fuel element performance cycle $\underline{i}$; t_r and t_a are the times in use and storage during one cycle; $t_t = t_{ra} + t_{ar}$; t_{ra} and t_{ar} are the times for fuel transfer from and back to the reactor; $\underline{n}$ is the number of cycles. In addition, another parameter was introduced for the γ energy delivered in the irradiation: $\eta_\gamma = \sum_{i=1}^{n} E_i^{\gamma} / \sum_{i=1}^{n} E_i^{\sigma} = \eta_\gamma(t_r, t_a, t_t, n)$, where E_i^{σ} is the γ energy emitted in cycle $\underline{i}$. Graphic and analytical expressions are developed for the functions in both expressions. The variations of $\overline{P}$ and η_γ in relation to t_t/t_r at various values $j = t_a/t_r$ and $n < 500$ are tabulated. The variations of the mean total γ energy ($P_{gen} = m\overline{P}_j$ at $m = j$) and η_γ at $t_t/t_r < 0.1$ are tabulated on the basis of the above data. The magnitudes $\overline{P}$ and η_γ as functions of t_r with $t_t = 1$ hour and fixed values for other magnitudes are analyzed and tabulated. (R.V.J.)

16976 RADIATION STABILITY OF ORGANOSILICON COMPOUNDS. John F. Zack, Jr., Earl L. Warrick, and Glenn Knoll (Dow Corning Corp., Midland, Mich.). J. Chem. Eng. Data, 6: 279-81(Apr. 1961).

Within the general area of silicones, compounds exist with a very wide range of sensitivity toward ionizing radiation. Siloxanes having a large amount of phenyl substitution exhibit a high degree of resistance to radiation damage. It is possible to estimate this degree of radiation resistance accurately as a function of composition. On the other hand, Si-H-containing compounds are particularly sensitive to radiation damage. Silicones should not be considered as a class, but be evaluated on the basis of specific siloxanes. (auth)

16977 EFFECTS OF IONIC AND FREE RADICAL PROCESSES IN THE RADIOLYSIS OF ORGANIC LIQUID MIXTURES. Lloyd J. Forrestal and William H. Hamill (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc., 83: 1535-41(Apr. 5, 1961).

The gamma-radiolyses of liquid cyclohexane, its dilute iodine-containing solutions, and various binary liquid mixtures over the complete range of composition are investigated. The systems and yields measured were: $G(H_2)$ and $G(C_6H_{10})$ in cyclohexane; $G(H_2)$, $G(C_6H_{10})$, $G(C_6H_{11}I)$, and G(HI) in cyclohexane–iodine; $G(H_2)$, $G(CH_4)$, $G(C_6H_{10})$, and G(HI) in cyclohexane–methyl iodide–10^{-2} M iodine; $G(H_2)$ and $G(CH_4)$ in cyclohexane–methyl iodide–10^{-2} M hydrogen iodide; $G(H_2)$ and G(HCl) in cyclohexane–chloroform; $G(H)_2$ and G(HCl) in cyclohexane–n-propyl chloride; $G(H_2)$, $G(CO_2)$, and $G(CH_4)$ in cyclohexane–benzyl actetate. The results are interpreted in terms of electron attachment and charge transfer as well as free radical reactions and energy transfer. (auth)

16978 GAMMA-INDUCED REACTIONS BETWEEN BORON HALIDES AND HYDROGEN. A. Levy, J. E. Williamson, and L. W. Steiger (Battelle Memorial Inst., Columbus, Ohio). J. Inorg. & Nuclear Chem., 17: 26-30 (Apr. 1961). (In English)

The results of a study directed toward the preparation of diborane by a γ-induced reaction between boron halides and hydrogen are reported. It is shown that diborane is not formed either as product or intermediate; instead, the irradiation of $BCl_3 - H_2$ or $BBr_3 - H_2$ mixtures induces the formation of HX and a white, stable polymer of the general formula $(BX_2)_n$ where X refers to the respective halogen. (auth)

16979 THE CHEMICAL EFFECTS OF NEUTRON CAPTURE IN CIS- AND TRANS-DICHLOROBIS-(ETHYLENE-DIAMINE)-COBALT(III) NITRATE. H. E. Rauscher (Brookhaven National Lab., Upton, N. Y. and Columbia Univ., New York), N. Sutin, and J. M. Miller. J. Inorg. & Nuclear Chem., 17: 31-42(Apr. 1961). (In English)

The kinetics of the isothermal annealing of Co^{60}(5.3 years) and Cl^{38}(37.5 min) recoil species in cis- and trans-$[Co(en)_2Cl_2]NO_3$ are investigated. After a given isomer was irradiated, neither Co^{60} nor Cl^{38} was found in any appreciable amount in the other isomeric form, nor did any appear as the other isomer upon annealing. Average energies of activation of 5 kcal/mole and 6.5 kcal/mole were found for the Co^{60} and the Cl^{38} annealing processes, respectively, which correspond to entropies of activation of −61 cal °C^{-1} $mole^{-1}$ and −56 cal °C^{-1} $mole^{-1}$. The increase in the retention of Co^{60} and Cl^{38} is described in terms of competitive reactions in the recoil sites. The increase in the retention due to isothermal-annealing processes occurring during the

lifetime of the hot zone was estimated, and was found to be negligible. (auth)

16980 RADIATION CHEMISTRY OF IONIC SOLIDS. I. DIFFUSION-CONTROLLED MECHANISM FOR RADIOLYSIS OF IONIC NITRATES. J. Cunningham (Argonne National Lab., Ill.). J. Phys. Chem., 65: 628-35(Apr. 1961).

The $G_{NO_2^-}$ values for the radiolysis of alkali-metal nitrates are determined at temperatures from −110° to 340°. The accuracy of the method was adequate to definitely detect a kinetic isotope effect in the rate of radiolysis of $KN^{14}O_3^{18}$ relative to $KN^{14}O_3^{16}$ at 25°. The ratio of the G-values of these isotopic KNO_3 materials was 1.03 ± 0.03 at −110° but 1.12 ± 0.02 at 25°. A model which identifies the rate-determining process in the radiolysis of the various nitrates as the jump probability for escape of the oxygen fragment from an excited NO_3^-, gives consistent results when treated by a theory developed for diffusion in metals. (auth)

16981 FERROCENE AS A RADICAL "SCAVENGER" IN THE RADIOLYSIS OF CARBON TETRACHLORIDE. E. Collinson, F. S. Dainton, and Hugh Gillis (The University, Leeds, Eng.). J. Phys. Chem., 65: 695-6(Apr. 1961).

The variation of ferrocene with dose was measured for solutions containing five different initial concentrations within the range 1.2 to 8.3m<u>M</u>. Graphs of optical density as a function of dose were linear down to a concentration of 0.5m<u>M</u> and correspond to $G(-Fn) = G(Fn^+Cl^-) = 2.34 \pm 0.7$, the minimum value for G_R. (N.W.R.)

16982 THE RADIOLYSIS OF BENZENE BY DENSELY IONIZING RADIATIONS. Philip B. Lorenz (Petroleum Research Center, Bartlesville, Okla.). J. Phys. Chem., 65: 703-4(Apr. 1961).

Preliminary experiments on the radiation decomposition of benzene by cyclotron helium ions and deuterons indicate that the yield of hydrogen is considerably in excess of that produced by fast electrons. Little effect on the yields of polymeric products is observed. Yields of gaseous products and of C^{12} products are tabulated. (N.W.R.)

16983 ON THE FORMATION OF H_2O_2 IN DEAERATED AQUEOUS SOLUTIONS UNDER THE INFLUENCE OF ^{60}Co RADIATION AND THE INFLUENCE OF HYDRATION ENERGY OF CATIONS ON THE AVERAGE YIELD OF THE INVESTIGATED PROCESS. Eugeniusz Wezranowski and Stefan Minc (Inst. of Nuclear Research, Academy of Sciences, Warsaw). Nukleonika, 6: 33-47(Jan. 1961). (In English)

The relation between the average yield of H_2O_2 in deaerated aqueous solutions and the hydration energy of cations added to the solutions from the standpoint of the Franck-Rabinowitsch "cage effect" is investigated. The following relation was obtained: $G = 1.2\ Q^{-0.29} - 0.062\ c$ where: G = average yield of H_2O_2 (molecules per 100 eV), Q = hydration energy (kcal per mole), c = concentration of cations (mole per liter) in the range 0.2 to 1.0 M. (auth)

16984 LOSS OF C^{11} FROM PLASTIC FOILS AND ITS EFFECT ON CROSS-SECTION MEASUREMENTS. J. B. Cumming, A. M. Poskanzer, and J. Hudis (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 6: 484-5 (May 1, 1961).

Polyethylene, "oriented" polystyrene, graphite, and a 95 mg/cm^2 polystyrene plastic scintillator are bombarded with 3 Bev protons. C^{11} is produced in the reaction $C^{12}(p,pn)C^{11}$; the loss of C^{11} activity is studied at liquid N and room temperatures. The percentage C^{11} loss for each target material is shown to be a function of target thickness (in mg/cm^2). The gas liberated from the scintillator upon radiation is found to contain radioactive hydrocarbon gases. (T.F.H.)

16985 EFFECTS OF IONIZING RADIATION ON THE VALENCE STATE OF NEPTUNIUM IN HYDROUS SOLUTIONS. A. D. Gel'man, M. P. Mefod'eva, A. K. Pikarev, and P. Ya. Glazunov. Radiokhimiya, 3: No. 1, 31-6(1961). (In Russian)

The effects of fast electrons on Np^{6+} in $HClO_4$(0.02 to 3.4N), HNO_3(0.05N), and H_2SO_4(0.86N) and Np^{4+} in 0.8<u>N</u> H_2SO_4 were studied. It is shown that NpO_2^+ is the most stable from the radiochemical point of view. The yield of Np^{5+} was evaluated for all solutions and it was found that the $G(NpO_2^+)$ value depends on the properties of the acid. Some postulations are made on the mechanisms of Np^{6+} and Np^{4+} reactions with water radiolysis products. (R.V.J.)

16986 SEPARATION OF RdTh FROM RADIO-MESOTHORIUM PREPARATIONS. D. M. Ziv and E. A. Volkova. Radiokhimiya 3: No. 1, 68-74(1961). (In Russian)

Separation of RdTh and RaD from radio-mesothorium preparations by precipitating $Ra(MsTh_1)Br_2$ from its saturated solution in methyl alcohol by a four-fold volume of 47% HBr is described. The yield of RdTh and RaD is 99.5 to 99.9%. The separation of RdTh and RaD is achieved by an alcohol-ether method comprised of RaD precipitation with $BaBr_2$ from a saturated solution in methyl alcohol by ether. The yield of RdTh is 86%. (R.V.J.)

16987 PREPARATION OF CONCENTRATED MsTh (Ac^{228}) PREPARATIONS. E. A. Volkova and D. M. Ziv. Radiokhimiya, 3: No. 1, 75-8(1961). (In Russian)

An alcohol-ether method was used for separating carrier-free Ac^{228} from Ra−MsTh bromide. The yield is 70 to 80%. The half life of Ac^{228} determined by its decay curve is 6.2 hours. (R.V.J.)

16988 CO-PRECIPITATION OF MICROQUANTITIES OF Sr^{90} WITH ACTIVE MANGANESE IN PRESENCE OF MICROQUANTITIES OF BARIUM AND CALCIUM. Yu. V. Egorov, V. V. Pushkarev, and E. V. Tkachenko. Radiokhimiya, 3: No. 1, 87-9(1961). (In Russian)

The competition between microquantities of Sr^{90} and microquantities of Ca and Ba in coprecipitations with active MnO_2 is subordinate to an equation which demonstrates that the log of the Sr^{90} distribution coefficient is a linear function of the log of the total molar ratio to the sorbent. The equation results from the law of mass action. It is shown that Ba acts stronger than Ca in suppressing Sr^{90} sorption by active MnO_2, leading to an assumption that the compounds of Ca and Ba formed in sorption have different stabilities to hydrolysis. (R.V.J.)

16989 SEPARATION OF TELLURIUM NUCLEAR ISOMERS. A.N. Murin, V. D. Nefodov, and O. V. Larionov. Radiokhimiya, 3: No. 1, 90-6(1961). (In Russian)

A method is developed for separating carrier-free, radiochemically pure ground state Te^{127} from a neutron bombarded tellurium dimethyldinitrate. The yield is nearly 100%. It was found that ~91% of the extracted Te^{127} is in the 4+ state and only 9% is 6+. (R.V.J.)

16990 SEPARATION OF CARRIER FREE Cd^{109} FROM CYCLOTRON TARGET. S. A. Grachev, V. N. Mel'nikov, Yu. A. Ryukhin, and M. A. Torpova. Radiokhimiya, 3: No. 1, 116-18(1961). (In Russian)

Separation of Cd^{109}, produced in a cyclotron target by the reaction $Ag^{109}(d,2n)Cd^{109}$ (half life 470 days), is complicated by large quantities of Ag^{110m}($T_{1/2}$ = 270 days) produced in $Ag^{109}(d,p)Ag^{110m}$ reactions. The nitric acid concentration of silver with Cd^{109} also results in large copper admixtures. Hence, microquantities of cadmium must be separated from large quantities of silver and copper. The separation was achieved by precipitation of AgI and Cu_2I_2. (R.V.J.)

16991 THE EFFECTS OF GAMMA RAYS ON THE SUPERCOOLING OF PARADICHLOROBENZENE. D. E. Ovsienko (Inst. of Metal Physics, Academy of Sciences of the Ukrainian, SSR). Soviet Phys.-Cryst., 5: 741-43(Mar.-Apr. 1961).

Gamma rays reduce the supercooling attainable with paradichlorobenzene. Nucleation tends to be centered on areas of the glass having structural damage. The radiation has only a secondary effect on spontaneous nucleation in the bulk of the liquid. (N.W.R.)

16992 THE APPLICATION OF THE ION-EXCHANGE METHOD IN THE RADIOCHEMISTRY. Ignacy Stroński (Inst. of Nuclear Physics, Krakow). Wiadomości Chem., 15: 13-37(1961). (In Polish)

The application of ion-exchange resins in radiochemistry and nuclear physics is reviewed. Special attention is drawn to the application of ion-exchange for separating rare earths, transuranium elements, and the products of iodine bombardment with 600-Mev protons. (auth)

16993 PHYSICAL AND CHEMICAL EFFECTS OF RADIATIONS. W. G. Burns (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.111-49 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Data are reviewed on the physical and chemical effects of radiations. Topics discussed include the radiation chemistry of aqueous solutions and the radiolysis of methane gas, n-alkane hydrocarbons, branched chain saturated hydrocarbons, cyclohexane, unsaturated hydrocarbons, benzene, biphenyl and terphenyls, alkyl iodides, and aliphatic alcohols. The importance of a knowledge of radiation effects is stressed. 92 references. (C.H.)

16994 INDUSTRIALLY IMPORTANT CHEMICAL REACTIONS INDUCED BY RADIATION. R. Roberts (Wantage Research Lab., Berks, Eng.). p.388-411 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

A survey is presented of industrially important chemical reactions which may be induced by radiation. Topics discussed include the effect of radiation on plastics and elastomers, the use of recoiling fission fragments in chemical synthesis, the use of fission product gases, the effect of radiation on hydrocarbons, radioinduced polymerization, polymerization in the solid state, polymerization of polyesters, radioinduced graft copolymerization, halogenation, sulfochlorination, oxidation of hydrocarbons, sulfoxidation of hydrocarbons, and the effects of radiation on catalysts. 75 references. (C.H.)

16995 REMOVAL OF RADIOTAGGED FATTY SOIL FROM A GLASS SURFACE. Jay C. Harris and R. M. Anderson (Monsanto Chemical Co., Dayton, Ohio). p.20-6 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

Comparative detergency values for removal of radiotagged tristearin from glass are given for several surfactant materials, illustrating the applicability of the radiotracer procedure to routine laboratory detergency evaluation. (auth)

16996 CALCIUM-45-TAGGED CLAY AS DETERGENCY TEST SOIL. J. W. Hensley and C. G. Inks (Wyandotte Chemicals Corp., Mich.). p.27-39 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

Some investigations were carried out with a test soil consisting of Ca^{45}-tagged clay dispersed in lubricating oil and applied to cotton swatches. This soil was employed in a miniature laboratory wash apparatus to evaluate soil removal and redeposition properties of detergents. Data are given on precision of the test method and effects on evaluations of certain test variables. Employing various detergent compositions as well as commercial laundry products, comparisons are made between evaluations with the oily tagged clay and a conventional carbon black soil. Pronounced contradictions were found in relative evaluations with the two methods, particularly with regard to the effect of alkalies as builders, the effectiveness of unbuilt nonionic surfactant, and the action of NaCMC in promoting whiteness retention of a built anionic surfactant. Evaluations with the tagged clay soil appear to be in better general accord with practical observations than those with carbon black soil. (auth)

16997 IMPROVEMENTS IN OR RELATING TO POLYEPOXIDE-THERMOPLASTIC POLYMER COMPOSITIONS. (to Swift & Co.). British Patent 861,791. Mar. 1, 1961.

A method is presented for producing flexible resinous materials which are insoluble and infusible. In this method, a shaped mixture of a polyepoxy compound and a thermoplastic polymer is exposed to high-energy ionizing radiation to give a product having improved resistance to melting at high temperatures and to dissolution in organic solvents, acids, and alkalies. (D.L.C.)

16998 PREPARING LUBRICATING OILS USING RADIATION. (to Esso Research and Engineering Co.). British Patent 865,636. Apr. 19, 1961.

A process for producing lubricating oils from paraffinic feed stock by the use of high-energy radiation is outlined. In this process, the feed stock containing at least 75 wt.% paraffins and boiling within 100 to 700°F is irradiated until a total dose of 5×10^{-3} to 1 kwh/lb is received, and a product fraction boiling within 750 to 950°F and having a viscosity of > 35 SSU/210°F and a viscosity index > 120 is recovered. (D.L.C.)

16999 IMPROVEMENTS IN OR RELATING TO THE CURING OF POLYMERS. (to General Mills, Inc.). British Patent 865,755. Apr. 19, 1961.

Certain mercuric salts (nitrates and salts of carboxylic acid, especially acetic acid) will react with polymers containing free $-CONH_2$ groups to form mercury-containing polymers which are resistant to mold, water, and radiation. Fabrics containing such polymers may be prepared, and several applications of the polymers are discussed. (D.L.C.)

Raw Materials and Feed Materials

17000 ELECTRONIC TREATMENT OF URANIUM ORES. Marcel Durand (L.I.E. Belin). Inds. atomiques, 5: No. 1-2, 105-9(1961). (In French)

Two apparatuses designed for the electronic preconcentration of uranium ores are described. Operational diagrams of both instruments are given. (J.S.R.)

Separation Processes

17001 (AERE-M-809) DEGRADED TBP-KEROSENE CLEAN-UP USING THE ALKANOLAMINES AND RELATED COMPOUNDS. E. S. Lane (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1961. 9p.

The metal-complexing compounds which are present in

degraded TBP-kerosene mixtures and which are unaffected by aqueous washing treatments are very effectively removed by solvent extraction with the alkanolamines such as monoisopropanolamine, triethanolamine, and others. (auth)

17002 (AERE-R-3551) FISSION PRODUCT RUTHENIUM IN EFFLUENT TREATMENTS. E. R. Gardner and P. G. M. Brown (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1960. 4p.

The categories of ruthenium complexes that exist in process solutions involving nitric acid were studied in relation to their behavior under certain typical floc precipitation conditions used in effluent treatment. It is concluded that nitrosyl ruthenium nitro complexes are primarily responsible for the poor ruthenium decontamination factors obtained in such processes. (auth)

17003 (DP-286(Del.)) EFFECT OF SOLVENT DEGRADATION ON THE PUREX PROCESS. Thomas H. Siddall, III and Richard M. Wallace (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1958. Decl. with deletions Mar. 18, 1960. Contract AT(07-2)-1. 23p.

The combined attack of HNO_3 and HNO_2 on TBP-kerosene solvents used in the Purex Process produces degradation products that cause abnormal quantities of zirconium to be extracted along with the plutonium and uranium and thus limits the decontamination. (auth)

17004 (IDO-14538) BARIUM FLUOZIRCONATE PRECIPITATION FROM HYDROFLUORIC ACID–ZIRCONIUM FUEL REPROCESSING SOLUTIONS. PART II. FISSION PRODUCT BEHAVIOR. B. J. Newby (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 21, 1961. Contract AT(10-1)-205. 17p.

Fission product distribution was characterized for the precipitation of barium fluozirconate from hydrofluoric acid–zirconium fluoride dissolver product solutions using three different precipitants. The variation of fission product, zirconium, and uranium behavior with dissolver and wash solution acidity was also studied. The relative distribution in process streams of radioactive decay heat was calculated. (auth)

17005 (KAPL-1098(Del.)) SEPARATION OF TRITIUM FROM HELIUM BY SORPTION ON PALLADIUM. R. M. Haag and F. K. Heumann (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 4, 1955. Decl. with deletions Dec. 20, 1960. Contract W-31-109-Eng-52. 51p.

Measurements were made of tritium separation from helium by sorption on palladium. The results may be approximated in some cases by assuming that the gas is at all times in equilibrium with palladium-tritide containing 1% of the saturation value of tritium. An equation describing the concentration waves moving through the bed with time is derived and compared with the experimental results. Where the equilibrium dissociation pressure is low, compared with the partial pressure of tritium in the gas phase, good agreement is obtained between theory and experiment. (auth)

17006 (ORNL-3084) SOLUBILITIES OF URANYL AND IRON(III) DIBUTYL AND MONOBUTYL PHOSPHATES IN TBP SOLVENT EXTRACTION SOLUTIONS. W. Davis, Jr. (Oak Ridge National Lab., Tenn.). May 3, 1961. Contract W-7405-eng-26. 17p.

The solubilities of uranyl dibutyl phosphate, uranyl monobutyl phosphate, ferric dibutyl phosphate, and ferric monobutyl phosphate were measured in aqueous nitric acid solutions ranging from 0 to 3 M and in 30% TBP in Amsco 125–82 solution containing 0–0.7 M HNO_3. For the respective compounds in the aqueous phases, as the acidity increased from 0 to 3 M, the solubilities increased from 0.004 to 0.7 g U/liter, 0.05 to 50 g U/liter, <1 to 30 mg Fe(III)/liter, and 0.003 to 3 g Fe(III)/liter; corresponding solubilities in the organic phases increased with acidity from 14 to 165 g U/liter, 11 to 110 g U/liter, <0.5 to 4 mg Fe(III)/liter, and <0.002 to 1.5 g Fe(III)/liter. All these compounds foamed or formed very flocculent solids in the aqueous phases and tended to settle slowly in the organic phases and rise to the surface in the aqueous phases, suggesting that they would be interface seekers in two-phase aqueous-organic systems. (auth)

17007 (AEC-tr-4553) PROCESSING OF IRRADIATED URANIUM ALLOYS BY FRACTIONAL SUBLIMATION OF THE CHLORIDES. Ph. Speeckaert (Brussels. Centre d'Etude de l'Energie Nucleaire). Sept. 1, 1960. Translated by Martha Gerrard from Report R-1915.

The method is based on the property of uranium chlorides of increasing vapor pressures with valence. Tests showed that Al–U, Nb–U, Mo–U, and U–Zr alloys can be treated with dry HCl, yielding a 99% separation for Al and Zr, but lower for Mo and Nb. The yield of uranium is found to be low because of partial oxidation during the process. The second sublimation of uranium, if useless for Zr^{95} + Nb^{95}, is useful in removing Ce^{141}, La^{140}, and Ru^{103}. (B.O.G.)

17008 AMMONIUM CARBONATE AS A MEANS OF SEPARATING URANIUM FROM IMPURITIES. N. P. Galkin, A. A. Maiorov, G. A. Polonnikova, V. G. Shcherbakova, and L. V. Utkina. Atomnaya Energ., 10: 233-7(Mar. 1961). (In Russian)

The dissolution of ammonium diuranate in $(NH_4)_2CO_3$ and NH_4HCO_3 was studied. It was found that in order to prevent the salting out of $(NH_4)[UO_2(CO_3)_3]$ the dissolution should be carried out in dilute solutions NH_4HCO_3. The optimum crystallization conditions for $(NH_4)_4[UO_2(CO_3)_3]$ were found to be 40°C, 30 g of uranium per liter of solution, and a 1-hr mixing time at 180 rpm. The separation of admixtures by ammonium carbonate was studied. The method did not prove efficient for the separation of potassium. (R.V.J.)

17009 SEPARATION OF URANIUM FROM IMPURITIES BY MEANS OF AMMONIUM SULPHITE. N. P. Galkin and G. A. Polonnikova. Atomnaya Energ., 10: 277-9(Mar. 1961). (In Russian)

The solubility of pure ammonium diuranate in ammonium sulfite was analyzed with the purpose of determining the factors and conditions conducive to the separation of uranium. The effects of $(NH_4)_2SO_3$ concentration, temperature, and the ratio of humid diuranate to liquid on solubility at 80°C were studied. The results show that the ammonium sulfite method will produce U_3O_8 with negligible admixtures. (R.V.J.)

17010 REACTION OF BERYL WITH SODIUM FLUOROSILICATE USED IN EXTRACTING BERYLLIUM FROM THE MINERAL. K. R. Hyde, P. L. Robinson, M. J. Waterman, and J. M. Waters (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Bull. Inst. Mining Met., 70: 397-406(Apr. 1961).

A study of the reaction of beryl with sodium fluorosilicate and its decomposition products sodium fluoride and silicon tetrafluoride is described. Sodium fluorosilicate itself is shown to be the agent mainly responsible for the release of water-soluble beryllium compounds. Its reaction with the beryl surface is rapid and the immediate products are a soluble sodium fluoroberyllate glass, cryolite and α-cristobalite. Longer heating, necessary to ensure the destruction of the rest of the beryl particle, and the attendant

increase in the sodium fluoride present, leads to the appearance of albite. Still longer heating allows a reaction between cryolite and α-cristobalite to provide a second source of albite. There is evidence that during its formation albite incorporates beryllium ions and that this is the reason for the fall in water-soluble beryllium salt as the time of heating is extended. A tentative reaction scheme is advanced and the practical implications of the results are indicated. (auth)

17011 THE SEPARATION OF NIOBIUM AND TANTALUM BY THE EXTRACTION OF NIOBIUM WITH N-BENZOYLPHENYLHYDROXYLAMINE (BPH). I. P. Alimarin, O. M. Petrukhin, and Yün-hsiang-Tsê (Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 1073-4(Feb. 11, 1961). (In Russian)

The radioactive tracers Nb^{95} and Ta^{182} were used to follow the separation of Nb and Ta from a stock solution containing 0.35 mg/ml of Nb_2O_5, 0.30 mg/ml of Ta_2O_5 and 3% tartaric acid. One ml of 10% alcohol solution of BPH was added to 4 ml of the standard solution. After formation of a precipitate, 5 ml of chloroform is added and the mixture is extracted for 3 minutes. It was found that 98 to 100% of the Nb is extracted at a pH of 4 to 6 by a single extraction, while Ta does not extract at all in this pH range. Nb can be rapidly separated from Ta by this method at ratios of Nb: Ta = 100:1 and 1:100. (TTT).

17012 RECOVERING URANIUM SUBMARINE REACTOR FUELS. R. P. Milford, Sydney Mann, John B. Ruch, and William H. Carr, Jr. (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., 53: 357-62(May 1961).

The ORNL fluoride volatility pilot plant was modified to study recovery of uranium from spent nuclear submarine fuel elements. The Zr-U elements are dissolved in NaF-LiF-ZrF_4 in a hydrofluorinator with anhydrous HF at 650 to 500°C. The UF_4 formed is converted to volatile UF_6 by reaction with elemental fluorine in a newly designed fluorinator at 500°C, purified in a NaF sorption-desorption cycle at 100 to 400°C in improved absorbers, and collected in a pair of cold traps. The UF_6 is liquefied and collected. New auxiliary equipment items required were an HF supply system, an HF neutralizer, a fuel element carrier-charger, a molten salt sampler, and a scrubber for removing traces of HF and F_2 from cell ventilation air. (auth)

17013 ANION EXCHANGE OF URANIUM IN NITRATE SOLUTIONS. John M. Googin, Lawrence R. Phillips, and Charles R. Schmitt (Union Carbide Co., Y-12 Plant, Oak Ridge, Tenn.). J. Chem. Eng. Data, 6: 217-19(Apr. 1961).

Uranium adsorbability from approximately 2M aluminum nitrate solutions is large enough to make recovery and purification feasible. Qualitative data indicate that adsorbed uranium may be rapidly and completely stripped from the resin by treatment with nitric acid-acidified water, yielding a concentrated uranyl nitrate product. The attainment of adsorption equilibrium conditions from 2M aluminum nitrate solutions was extremely slow for the relatively coarse 16- to 20-mesh Dowex 21K resin used. However, adsorption kinetics may be increased appreciably by decreasing the resin particle size, raising the temperature, or making a judicious choice of nitrate salt molarity. (auth)

17014 PURIFICATION OF IRRADIATED TRIBUTYL PHOSPHATE BY DISTILLATION IN KEROSENE-TYPE DILUENT. Fred Sicilio, T. H. Goodgame, and Bert Wilkins, Jr. (Georgia Inst. of Tech., Atlanta). Nuclear Sci. and Eng., 9: 455-61(Apr. 1961).

The feasibility of purifying irradiation-degraded Purex-type solvent by distillation is indicated. Direct fractional distillation does not appear to be feasible; however, flash distillation of the mixture into separate TBP and Amsco components and subsequent fractional distillation of each component can be performed. The results indicate that a washing operation and several flash distillations should suffice for purification of solvent irradiated up to 120 w-hr/liter. (auth)

17015 NEW DEVELOPMENTS IN URANIUM–ZIRCONIUM ALLOY FUEL REPROCESSING. T. A. Gens (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 9: 488-94(Apr. 1961).

Processes for dissolving U-Zr and Nb-U-Zr alloy fuels in ammonium fluoride solutions (Modified Zirflex processes) are developed. A nonaqueous process (Zircex process), in which high-zirconium alloys are hydrochlorinated at about 600°C, offers the possibility of zirconium separation prior to solvent extraction. Dissolvents consisting of hydrofluoric acid–hydrogen peroxide or hydrofluoric acid–nitric acid–aluminum nitrate mixtures are also attractive, but corrosion rates with common construction materials prove excessively high. (auth)

17016 THE RECOVERY OF URANIUM FROM LEACHING LIQUORS BY SOLVENT EXTRACTION WITH DODECYL PHOSPHORIC ACID. Tadeusz S. Urbański (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 831-43(1950). (In Polish)

Studies on solvent extraction of uranium from leach liquors of the Polish uranium ores by dodecyl phosphoric acid (DDPA) in mepasine are described. The way of liquid-solid separation markedly affects U^{6+} and Fe^{3+} contents in the solution. This can be probably explained by various degrees of adsorption on the solid. When filtration was used the highest concentrations of U and Fe in the solutions are observed. When sedimentation was applied, the concentrations of both elements were lower but their concentrations decrease was not always proportional to the dilution as well as not parallel for these metals. The addition of flocculants has only a small effect on the extraction coefficient value E_w^0 for U^{6+} and Fe^{3+}. For example in the presence of the separan the E_w^0 value for U^{6+} increases while that for Fe^{3+} remains almost constant. In order to lower the iron extraction as well as to increase the uranium extraction, Fe^{3+} was reduced to the nonextractable form of Fe^{2+}. The reduction goes well when Fe metal, $NaHSO_2 \cdot HCHO$, or $Na_2S_2O_4$ are used. It is established that the reduction of the $Fe^{3+} \rightarrow Fe^{2+}$ and $U^{6+} \rightarrow U^{4+}$ occurs under the influence of hydrogen when Fe metal is used. The influence of the organic phase composition on the U and Fe extraction is also investigated. It is found that the E_w^0 of U^{6+} depends on the DDPA concentration in the first power [DDPA] and the E_w^0 Fe^{3+} in the $[DDPA]^{3/2}$, respectively. The presence of the dodecyl alcohol in the concentration range up to 1 mole/l mole DDPA does not affect the uranium extraction but does lower the iron extraction. (auth)

17017 EXTRACTION OF URANIUM FROM SULFATE SOLUTIONS BY TRI-n-OCTYLAMINE. Czeslaw Deptula and Wincenty Korpak (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 845-54(1960). (In Polish)

The conditions of obtaining of uranium concentrates by extraction of uranium from sulfate leach liquors using tri-n-octylamine are investigated. It has been shown that 0.1 M TnOA solution in kerosene containing about 2 per cent (V/V) of n-octanol is suitable for the recovery of uranium from the Polish leach liquors. The use of kerosene as a diluent for TnOA needs the addition to the organic

phase of some per cent of n-octyl alcohol. This addition causes an increase of the solubility of tri-n-octylamine salt in the organic phase, and a synergistic increase of the uranium extraction at the mole ratio of alcohol to amine ranging from 0.95 to 1.59, and a decrease of the iron extraction. An increase of uranium concentration in the organic phase causes a decrease of the extraction coefficients of the other cations present in leach liquors. An increase of pH value of the solution causes an increase of the extraction of iron(III) and uranium(IV) by TnOA. (auth)

17018 THE INFLUENCE OF HYDROLYSIS PRODUCTS OF TRI-n-BUTYLOPHOSPHATE ON URANYL NITRATE EXTRACTION PROCESS BY 40 PER CENT TBP KEROSEN SOLUTION. Czeslaw Deptula and Wincenty Korpak (Inst. of Nuclear Research, Academy of Sciences, Warsaw). Nukleonika, 6: 49-56(Jan. 1961). (In Polish)

The influence of hydrolysis products of tri-n-butylphosphate (MBP, DBP and butanol) on the uranyl nitrate extraction process by 40 per cent TBP in kerosene solution is investigated. The slight influence of TBP hydrolysis products on the uranium extraction caused an increase in the extraction of the other cations such as Fe^{3+}, Cd^{2+}, Mn^{2+}, Zn^{2+}, and the latter effect lowered the efficiency of a purification process. Nevertheless at a high uranium concentration in the organic phase the product was of similar purity to that observed in extraction by pure 40 per cent TBP. Di-n-butyl phosphate formed very stable complexes with uranium and it is impossible to carry out the reextraction of uranyl nitrate from the organic phase in the aqueous one. TBP with Al^{3+}, Fe^{3+}, Zr^{4+}, and UO_2^{2+} cations formed salts slightly soluble in water and kerosene but very soluble in TBP and nitric acid. The presence of MBP in 40 per cent TBP solutions has provided the difficulty in uranyl nitrate reextraction by water, as the precipitate of uranyl salt of monobutylphosphate acid was formed. (auth)

17019 SEPARATION OF Th FROM SULFURIC ACID BY OCTYLAMINE. V. M. Vdovenko, M. P. Koval'skaya, and E. V. Shirvinskii. Radiokhimiya, 3: No. 1, 1-6(1961). (In Russian)

Separation of thorium from acid sulfate solutions by primary amine and mixtures of primary aliphatic amines and chloroform was studied. It was found that chloroform does not extract thorium. The distribution coefficient for thorium drops sharply with an increase in sulfuric acid concentration in hydrous solution. The proportionality between the thorium distribution coefficient and amine concentration in the organic phase was observed; from one thorium sulfate molecule two amine sulfate molecules pass into the organic phase. The complex extracted compound is expressed as $(C_8H_{17}NH_3)Th(SO_4)_4$. (R.V.J.)

17020 EXTRACTION OF SULFURIC ACID AND URANYL SULFATE BY TBP. V. V. Shevchenko and Yu. F. Zhdanov. Radiokhimiya, 3: No. 1, 7-9(1961). (In Russian)

Uranyl sulfate and sulfuric acid are weakly extracted by tributyl phosphate. In uranyl sulfate extraction sulfuric acid acts as a salting-out agent. A plot of $K_d = f(TBP)$ indicates values of 2.2 for sulfuric acid and 3.3 for uranyl sulfate. (R.V.J.)

17021 CATION SALTING OUT EFFECT AND COVALENCE OF THEIR REACTION WITH SOLUTION WATER MOLECULES. A. A. Kuznetsova, O. Ya. Samoilov, and V. I. Tikhomirov. Radiokhimiya, 3: No. 1, 10-13(1961). (In Russian)

Coefficients of uranyl nitrate distribution between diethyl ether and hydrous solutions containing rubidium, thallium(I), cobalt(II), and nickel(II) nitrates were determined. A reduced salting-out efficiency was observed with increased covalent reaction of salting-out cations with water molecules. (R.V.J.)

17022 THE RELATION BETWEEN THE SALTING OUT EFFICIENCY AND HYDRATION OF SALTED OUT IONS. O. Ya. Samoilov, V. I. Tikhomirov, V. P. Ionov, and A. A. Kuznetsova. Radiokhimiya, 3: No. 1, 14-18(1961). (In Russian)

The magnitudes of ΔE (salting out) depend on the properties of the salting-out agent and the salted-out ion. With the increase of ion hydration the magnitude ΔE (salting out) increases. It was found that the relation between the ΔE and hydration results in $(a^1/a^2)_i > (a^1/a^2)_j$. The latter is confirmed by experiments on the extraction of uranyl and thorium by tributyl phosphate from hydrous solutions containing magnesium, calcium, and strontium nitrates. (R.V.J.)

17023 INVESTIGATIONS OF PROTACTINIUM STATE IN HYDROUS SOLUTIONS BY EXTRACTION METHOD. L. D. Sheidina and L. I. Il'menkova. Radiokhimiya, 3: No. 1, 24-30(1961). (In Russian)

The $Pa(OH)_4^{0,5+}$ ion is prevalent at pH 0 to 2. A more complex ion, with a small positive charge, forms at increased pH. Protactinium hydroxide begins to form at pH = 5. Data on Pa^{233} extraction by 25% TBP in benzene from solutions at pH 0 to 9 are in good agreement with the postulated states of protactinium. The neutral forms of protactinium increase at increased acid concentration (from 1 to 14N HNO_3). It is suggested that the neutral forms vary their compositions in transition from 1 to 3N to 3 to 5N HNO_3. (R.V.J.)

17024 NON-AQUEOUS SOLVENTS IN ANION-EXCHANGE SEPARATIONS. James S. Fritz and Donald J. Pietrzyk (Ames Labs., Ames, Iowa). Talanta, 8: 143-62 (1961). (IS-166)

Distribution coefficients are measured for the partition of metal ions between anion-exchange resin and organic solvent-water mixtures containing hydrochloric acid. The presence of an organic solvent causes metal ions to be taken up at lower hydrochloric acid concentrations. In many cases, distribution coefficients are significantly higher than in water-hydrochloric acid systems. If other conditions are comparable, the order of distribution coefficients in alcohol-water-hydrochloric acid is: isopropyl > ethyl > methyl alcohol. Column separations of metal ion mixtures can be carried out by eluting with alcohol-water-hydrochloric acid mixtures of different compositions. Successful separations of a number of mixtures are reported. (auth)

17025 SEPARATION OF INDIVIDUAL FISSION PRODUCTS. T. V. Healy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.324-48 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Methods are discussed for separating fission products from highly active waste streams. Emphasis is placed on the removal of Cs^{137} and Sr^{90}. Methods are outlined for their separation both individually and together. The large scale production of Cs^{137} for use as a γ source, applications of Sr^{90} as a β source, and possible applications of other separated fission products as radiation sources are discussed. (C.H.)

17026 IMPROVEMENTS IN OR RELATING TO THE RECOVERY OF PLUTONIUM. Normal James Keen and Herbert Alwyn Cochrane McKay (to United Kingdom Atomic Energy Authority). British Patent 865,699. Apr. 19, 1961.

A process is given for recovering Pu from fluoride slags.

The process comprises dissolving the slag in a solution of ≥ 1.5 M $Al(NO_3)_3$ and ≥ 3 M HNO_3 at 90 to 95°C and extracting the Pu from the solution with a kerosene solution of tributyl phosphate. After slag dissolution has reached the point where no further Pu dissolution occurs, the undissolved residue may be contacted with concentrated HNO_3 at 95°C to ensure complete Pu dissolution. Sufficient volume of dissolving solution must be used to prevent precipitation of the fluoride of the reducing metal on cooling of the solution. (D.L.C.)

17027 METHOD AND MEANS FOR ELECTROLYTIC PURIFICATION OF PLUTONIUM. (to U. S. Atomic Energy Commission). British Patent 865,737. Apr. 19, 1961.

A method is described for electrodepositing Pu from a fused halide salt bath at temperatures less that 600°C and for purifying Pu reactor fuels from fission products. In this method, a low-temperature bath of $PuCl_3$ and one or two of the chlorides of Li, Na, and K are electrolyzed with an anode cup containing a Pu alloy and an iron cathode. Since the eutectic of Pu–Fe alloy is at 410 to 430°C, a molten Pu–Fe alloy forms at the cathode and drips down into a container below the cathode. The advantages of the method are that at the low temperatures, oxidation problems are avoided and the alloy is deposited in a massive form instead of a powdery form. An electrolytic cell for use with the method is described. (D.L.C.)

17028 PRODUCTION OF PLUTONIUM FLUORIDE FROM BISMUTH PHOSPHATE PRECIPITATE CONTAINING PLUTONIUM VALUES. Harrison S. Brown and Edward G. Bohlmann (to U. S. Atomic Energy Commission). U. S. Patent 2,982,599. May 2, 1961.

A process is given for separating plutonium from fission products present on a bismuth phosphate carrier. The dried carrier is first treated with hydrogen fluoride at between 500 and 600°C whereby some fission product fluorides volatilize away from plutonium tetrafluoride, and nonvolatile fission product fluorides are formed then with anhydrous fluorine at between 400 and 500°C. Bismuth and plutonium distill in the form of volatile fluorides away from the nonvolatile fission product fluorides. The bismuth and plutonium fluorides are condensed at below 290°C.

17029 URANIUM DECONTAMINATION WITH RESPECT TO ZIRCONIUM. S. Vogler and M. Beederman (to U. S. Atomic Energy Commission). U. S. Patent 2,982,600. May 2, 1961.

A process is given for separating uranium values from a nitric acid aqueous solution containing uranyl values, zirconium values and tetravalent plutonium values. The process comprises contacting said solution with a substantially water-immiscible liquid organic solvent containing alkyl phosphate, separating an organic extract phase containing the uranium, zirconium, and tetravalent plutonium values from an aqueous raffinate, contacting said organic extract phase with an aqueous solution 2M to 7M in nitric acid and also containing an oxalate ion-containing substance, and separating a uranium-containing organic raffinate from aqueous zirconium- and plutonium-containing extract phase.

17030 SEPARATION OF URANYL AND RUTHENIUM VALUES BY THE TRIBUTYL PHOSPHATE EXTRACTION PROCESS. Archie S. Wilson (to U. S. Atomic Energy Commission). U. S. Patent 2,982,601. May 2, 1961.

A process is given for separating uranyl values from ruthenium values contained in an aqueous 3 to 4 M nitric acid solution. After the addition of hydrogen peroxide to obtain a concentration of 0.3 M, the uranium is selectively extracted with kerosene-diluted tributyl phosphate.

17031 CESIUM RECOVERY. Theodore R. McKenzie and Wallace W. Schulz (to U. S. Atomic Energy Commission). U. S. Patent 2,982,785. May 2, 1961.

A process is given for extracting cesium from an aqueous acid or alkaline solution with a hexone solution of sodium tetraphenyl boron.

17032 SALT CONVERSION PROCESS. Harold H. Van Tuyl (to U. S. Atomic Energy Commission). U. S. Patent 2,985,505. May 23, 1961.

A method is given for extracting cesium values from a complex cyanide precipitate brought down in a fission product recovery process. The precipitate is agitated in a slurry with silver carbonate and filtered. The filtrate, which contains only cesium carbonate, is then treated with hydrochloric acid which drives off CO_2, and leaves a simple solution of CsCl.

ENGINEERING AND EQUIPMENT

General and Miscellaneous

17033 (CF-61-3-121) HECT II COMPRESSOR PRESSURE DROP TEST. F. A. Flint (Oak Ridge National Lab., Tenn.). Mar. 30, 1961. 21p.

Pressure drop tests were performed on a HECT II compressor with air at 14.7 psia and 80°F over a flow rate range of 50 to 200 lb/hr for both the "turbine stationary" and the "turbine free" conditions. Pressure drop data for both conditions are presented. Tables of head loss coefficients are included for both the incompressible flow and the compressible flow cases over a Reynolds' number range of 16,000 to 60,000. Curves of pressure drop across the compressor are included for air at 14.7 psia and 80°F and helium at 314.4 psia and 600°F over a Reynolds' number range of 16,000 to 60,000. (auth)

17034 (CF-61-3-129) TrU FACILITY—ALPHA BOX ACCESSORIES—SPHERICAL JOINT CLAMP. B. B. Klima (Oak Ridge National Lab., Tenn.). Mar. 28, 1961. 4p.

A special clamp was designed and developed which is remotely manipulator operable and which will clamp a standard spherical (glass) joint. This clamp was needed and will be used in conjunction with operational equipment within an alpha-tight box used in connection with the Transuranium Process in the TrU Facility. (auth)

17035 (HW-52290(Del.)) CONTINUOUS CALCINER OFF-GAS SCRUBBER. W. R. Hamilton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 20, 1957. Declassified with deletions Feb. 29, 1960. 10p.

A test was made of an off-gas scrubber proposed for installation in the continuous calciner off-gas stream in place of wire cloth filters. Four UO_3-removal efficiency runs were made in a 6-in.-diameter "disk and donut" water-curtain scrubber. The efficiency was 90 to 95% when the flows were set to maintain a completely wet column wall and the efficiency was 75 to 85% when gas flow was insufficient to completely wet the column wall. Liquid rate was found to have only a minor effect on the flooding gas flow rate obtained with any given plate spacing. (M.C.G.)

17036 (IS-273) A CONDENSER FOR THE VACUUM DISTILLATION OF METALS. G. Burnet and W. Buchanan (Ames Lab., Ames, Iowa). Feb. 1961. Contract W-7405-eng-82. 16p.

A condenser, suitable for use in the distillation of metals was designed. The temperature of the condensing surface was established by controlling the pressure over boiling NaK-78 contained within the condenser. Performance was evaluated in test units in which pure bismuth was distilled as the test metal. (auth)

17037 (NP-10050) OBSERVATIONS ON THE PERFORMANCE OF SELF-ACTING GAS JOURNAL BEARINGS. Richard Elwell (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Mar. 3, 1961. Contract NONR 2844(00). 31p.

Investigations were made of the performance of self-acting, gas-lubricated bearings. A theory for the occurrence of the phenomenon of half-frequency whirl in plain journal hearings is discussed. An evaluation of the stability of these bearings is presented on the basis of different forms of energy contained within the gas film in order to predict the threshold of the whirl instability. A study was also made of moisture condensation in the gas film of bearings under a rotating unbalance load (synchronous whirl). Wide variations in relative humidity, load, L/D ratio, and speed were employed. The results showed a consistent effect due the ratio of bearing load to ambient pressure. (auth)

17038 (NP-10053) AUTOMATIC FEEDRATE REGULATION IN NUMERICALLY CONTROLLED CONTOUR MILLING. Report 8436-R-1. Jerry D. Welch (Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.). Dec. 1960. Contract AF-33(600)-40604. 64p.

The application of continuous path numerical control and tracer control to machine tools increased the need for a more automatic and accurate method of feedrate selection. A method of using a feedback signal from the cutting process to determine the desired feedrate is presented as a solution to this problem. The choice of the proper feedback signal was first considered. It is shown that whereas a computer regulation system is best suited to controlling the metal removal rate, a feedback regulation system is best suited to controlling the tool wear rate. The tool temperature is known to be the output of the cutting process which is most closely related to the tool wear rate. The method chosen for detecting the tool temperature is the tool-work thermocouple technique. An experimental system for regulating the feedrate of the M.I.T. numerically controlled milling machine is described. The results show that subject to certain restrictions the tool-work thermal emf can be successfully fed back to control the machine feedrate so as to keep the cutting temperature essentially invariant to changes in the cross section of the cut. (auth)

17039 (SCTM-67-61-13) SOLUTION TO AN EXPLOSIVE SWITCH PRODUCTION PROBLEM THROUGH THE USE OF QUALITY CONTROL. J. R. Craig, T. C. Preston, and R. A. Wilson (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. Contract AT(29-1)-789. 13p.

A quality control philosophy which led to the successful evaluation of problem areas during the production of explosive switches is described. An illustration of the use of this philosophy in solving a specific production problem is presented in detail. An estimated percentage cost comparison is made of explosive switch production with and without the use of extensive quality control. (auth)

17040 (TID-12473) STUDY ON VIBRATIONS AND PRESSURE LOSSES IN CLUSTERS OF TUBES. Quarterly Report on Activities for the 4th Quarter of 1960. P. Leon (Société Grenobloise d'Étude et d'Applications Hydrauliques, Grenoble, France). EURATOM Contract ML/26.1.1961. EURATOM/U.S.A. Agreement Proposal No. 89. 19p. (Includes original, in French, 11p.). AEC 171/Euratom 89

A bibliographical search into theoretical and experimental studies on similar subjects was carried out. Tests were developed to measure experimentally the natural vibration frequencies of simple mechanical models of two types: those having only one tubular element and those formed by identical tubular elements grouped in clusters of parallel tubes. Both hollow and solid stainless steel tubes will be used in the tests. (M.C.G.)

17041 TRACER METHODS FOR RAPID DETERMINATION OF UNIFORMITY OF MIXING. Robert M. Main (Tracerlab, Inc., Richmond, Calif.). p.74-80 of "Symposium on Applied Radiation and Radioisotope Test Methods.

ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

Tracer techniques can be used effectively for routine quality control of the homogenity of mixtures. The application to quality control is discussed for erratic and reproducible mixing along with sample size theoretical estimations. This technique is controlled by the amount of activity which will affect the solution and product during the mixing. (N.W.R.)

17042 TRACER TECHNIQUES FOR THICKNESS OF VERY THIN VACUUM-EVAPORATED METAL FILMS. Luther E. Preuss (Edsel B. Ford Inst. for Medical Research, Detroit). p.81-99 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

The direct tracer scheme for films below 100A and its application to the condensand at the mono-layer and below is discussed. Through the use of the tracer technique it is possible to calibrate a given routine and to predict accurately the condensand thickness, the distribution pattern, the purity of condensate, the distillation of more than one agent, and even the source geometry and distillation rate. Autoradiography will give profiles and describe distribution anomalies. With this information, a given distillation process or development study may be accurately controlled and assessed. The advantages of this method are high sensitivity; direct, nondestructive, and variety of application; speed; and accuracy. The disadvantages are personnel irradiation, limitation to pilot tests, contamination problems, and added instrumentation costs. (N.W.R.)

17043 ARTICULATED MANIPULATOR. (to General Mills, Inc.). British Patent 865,517. Apr. 19, 1961.

An articulated manipulator or material handling unit for use in uninhabitable environments is designed with many degrees of freedom. The unit consists of manipulating arms extending from a vehicle provided with a protective cab. This unit is especially suitable for dismantling nuclear aircraft engines. (D.L.C.)

17044 IMPROVEMENTS IN OR RELATING TO SEALING RINGS AND SEALING ASSEMBLIES. Harrison John Hall-Wilton and William Paul White (to United Kingdom Atomic Energy Authority). British Patent 865,654. Apr. 19, 1961.

A sealing ring and assembly for closing large diameter ports is designed with substantial flexibility so that a considerable variation in the location of the sealed faces can be tolerated. The sealing ring offers a resilient sealing face in the form of a series of concentric angular tongues curved so that contact pressure increases with the pressure on the concave faces of the tongues. (D.L.C.)

17045 SOURCE OF RADIOACTIVE RADIATION AND A METHOD OF PRODUCING THE SAME. (to Deutsche Edelstahlwerke A. G.). British Patent 865,773. Apr. 19, 1961.

Radioactive sources which are convenient to handle and use may be fabricated by employing the radioactive material in a permanent magnet. Thus, sources may be temporarily fixed to ferromagnetic objects, etc., without mechanical clamping devices. One way is to attach the source to a ferromagnetic ball which may be remotely turned to place the source in any desired position. Several possible ways of fabricating such sources are described. (D.L.C.)

17046 TELETHERAPY HEAD. (to Nuclear Corp. of America, Inc.). British Patent 865,817. Apr. 19, 1961.

A teletherapy head is designed wherein a radioactive source is moved from a safety position deep within the head shielding to a position adjacent to an aperture to permit emanation of radiation. The head has within itself a tubular track curved to a safety position near the center of the head and an aperture adjacent to the track. The source is in the form of an innermost source link attached to shielding links in the form of a train which is moved by an outside motor to position the source either in the safety position or in the irradiation position. The links are joined by means of tongue-and-groove mating surfaces formed in such a way that jamming or disengagement cannot occur. (D.L.C.)

17047 IMPROVEMENTS RELATING TO THE SECURING OF COVERS OR LIDS ON PRESSURE VESSELS OR CONDUITS. Eric Frederick Walker (to Elliott Brothers Ltd.). British Patent 867,401. May 10, 1961.

A design for a clamping mechanism is given. The mechanism consists of a plurality of toggle-operated clamps interposed between a cover or lid to be clamped to a vessel and a manipulator common to all clamps and adapted for simultaneous operation. The toggle clamps automatically engage the abutment surfaces on the vessel when the cover is placed in position. The clamps are held in operative positions by fluid pressure upon the cover. (N.W.R.)

17048 TUBE SPLITTING APPARATUS. Charles E. Frantz and William E. Cawley (to U. S. Atomic Energy Commission). U. S. Patent 2,983,042. May 9, 1961.

A tool is described for cutting a coolant tube adapted to contain fuel elements to enable the tube to be removed from a graphite moderator mass. The tool splits the tube longitudinally into halves and curls the longitudinal edges of the halves inwardly so that they occupy less space and can be moved radially inwardly away from the walls of the hole in the graphite for easy removal from the graphite.

17049 BROACHING AND TUBE-INSTALLING APPARATUS. Charles E. Frantz and William E. Cawley (to U. S. Atomic Energy Commission). U. S. Patent 2,983,989. May 16, 1961.

An apparatus is given for sizing long holes in graphite bodies. The apparatus comprises a shaft having 3 spiral broach cutting elements and a straight broach cutting element rotatably mounted thereon. The broach cutting elements are keyed to each other in end to end relationship with the straight broach cutting element at one end of the shaft. The spiral broach cutting elements when considered toward the straight broach cutting element increase in diameter and the cutting teeth thereon increase in lead angle. The straight broach cutting element, when considered in the same direction, increases in diameter from the minimum to maximum diameters of the spiral broach cutting elements. No longitudinal movement of the broach cutting elements is permitted on the shaft and means are provided for the removal of chips from the apparatus.

17050 MODIFIED BALL AND SOCKET COUPLING. W. R. Conley, Jr. and R. W. Pitman (to U. S. Atomic Energy Commission). U. S. Patent 2,984,995. May 23, 1961.

A ball and socket coupling arrangement is given in which the male and female members may be engaged or disengaged without visual aid. The female member has an internal spherical seat through which slots are provided to accommodate appropriately arranged and shaped ribs in the male ball member. After engagement of the members, one or both are rotated to lock them together to prevent accidental disengagement.

Heat Transfer and Fluid Flow

17051 (AD-243827) INTERFEROMETER STUDY OF HEAT TRANSFER FROM HORIZONTAL CYLINDERS IN

FREE CONVECTION (thesis). Luke H. Boykin, Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1960. 44p.

The average and local non-dimensional heat-transfer coefficients are determined for systems of horizontal cylinders in free convection. A single cylinder is investigated and compared with different spacings of two level cylinders, three cylinders in an equilateral triangular arrangement, and four cylinders in a diamond form. The positions of the cylinders in each arrangement are varied in small increments from positions of isolation to positions of interaction. Curves are presented which indicate the relative heat-transfer coefficients for all of the arrangements and spacings studied. Mutual interaction is seen to increase the heat-transfer film coefficient of some positions while it decreases in others. Interferometer photographs of several interesting arrangements are presented with graphs of the corresponding local heat-transfer coefficients. (auth)

17052 (AERE-M-804) THE DERIVATION OF A GENERALISED CHART FOR SPIRAL-GROOVE THRUST PLATE PERFORMANCE. P. Fortescue (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). 1960. Date of MS. Dec. 1952. Decl. Dec. 1960. 7p.

Declassified Version of AERE-ED/M-21.

The chart is generalized Whipple solution which refers to the uncompressible flow case. Experiments with 5-in. thrust plates to 15000 rpm show little evidence of departure from this condition. The results with all spiral-groove thrust plates tested are found to agree closely with the chart predictions. (B.O.G.)

17053 (AERE-R-3522) FLOW PATTERNS IN GAS FLUIDISED BEDS. P. F. Wace and S. J. Burnett (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishement, Harwell, Berks, England). Oct. 1960. 19p.

The following methods were used to detect the direction and velocity of gas streams moving through fluidized beds: injection of a visible trace of nitrogen dioxide, and measurement of pressures round an artificial gas bubble. It was found that pressure gradients exist toward the base of void spaces in fluidized beds. The gradients give rise to horizontal drag forces on particles and, because of their transitory nature, to rapid changes of direction of the local gas flow. The observations indicate the order of magnitude of gas channeling effects in fluidized beds and the mechanism by which solids reform in the wake of bubbles. (auth)

17054 (BNL-657) HEAT TRANSFER STUDY OF COBALT-60 SHIPPING CONTAINER. Progress Report No. 1. L. B. Adler (Brookhaven National Lab., Upton, N. Y.). Mar. 1961. 23p. (BNL-T-213).

Heat transfer studies were made of a 7-ton cobalt-60 shipping container with approximate 83,000-curie cobalt loading. Measured surface temperatures indicate that heat removal aspects of the container will not limit its usage, i.e., the loading studied will be safe as regards possible activity leakage due to heat generation under normal shipping conditions and in any situation wherein a reasonable natural-convective heat transfer condition is maintained at the container surface. The important heat flows controlling heat dissipation were also defined; in addition to the expected convective and radiative effects, it appears that contact heat conduction through the cobalt holder assembly may be a significant heat removal factor. (auth)

17055 (GEAP-3261) HERCULES I. THE STEADY-STATE CALCULATION OF VERTICAL TWO-PHASE FLOW. E. S. Beckjord and W. H. Harker (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 9, 1959. 26p. (R59APE35)

Theoretical equations of two-phase steam and water flow in vertical uniform channels with heat addition are derived. The method of numerical integration which was employed for computer solution is explained. Calculated results are compared with the data taken first by Cook and later by Marchaterre at Argonne National Laboratory, and are found to correspond well. (auth)

17056 (LA-2486) STEADY-STATE TEMPERATURE SOLUTION FOR A HEAT-GENERATING CIRCULAR CYLINDER COOLED BY A RING OF EQUAL HOLES. J. C. Rowley and J. B. Payne (Los Alamos Scientific Lab., N. Mex.). Dec. 1, 1960. Contract W-7405-eng-36. 126p.

An analytical solution is presented to the steady-state heat-conduction equation for a heat-generating circular region which is cooled by a ring of equal holes spaced uniformly on a circle concentric with the boundary of the cylinder. The solution is based upon a class of harmonic functions previously defined by Howland. Numerical results are presented in the form of dimensionless curves for the particular examples of (a) uniform heat generation within the region with cooling at the holes and insulated outer boundary, and (b) the shape factor or conductance for this geometry. (auth)

17057 (NYO-9646) BASIC STUDIES IN HEAT TRANSFER AND FLUID FLOW. Quarterly Progress Report, January 1, 1961 to March 31, 1961. T. Diskind, D. Lee, R. Lummis, and J. Vohr (Columbia Univ., New York. Engineering Research Labs.). Contract AT(30-2)-187. 82p. (IX-QPR-1-61).

Nucleate Boiling Heat Transfer. Data collected for tubular nickel heating elements are presented in the form of heat flux density vs surface temperature graphs at constant pressure and water velocity. The results indicate that velocity and liquid subcooling variations do not have an appreciable effect on the heat transfer coefficient in subcooled nucleate boiling, but that increasing the pressure level causes the convection-boiling transition in heat transfer to occur at higher surface temperatures. The location of the burnout points suggests that the maximum achievable heat flux density is increased by increased subcooling. Transient Vaporization. Several thin-film heaters were calibrated and the results presented in the form of resistance vs temperature graphs. The value of 4000 ohms is chosen as the optimum value for the heater resistances. The appearance of the heaters before and after film and nucleate boiling with hexane was studied. Forced Convection Boiling. A photographic method is presented for determining flow pattern velocities. An analytical method for predicting void fraction and pressure drop for vertical, upward, two-phase flow in the bubble flow region is examined, and comparisons between the bubble flow model and experiment are given. Convection Heat Transfer in Non-Circular Ducts. The deviation of experimental heat transfer coefficients for eccentric annuli from those predicted by Stein-Begell concentric equation is ascribed to circumferential temperature variations. Pressure drop runs were made with a 92% eccentric annulus and the data presented in the form of a friction factor vs Reynolds number graph. A method is outlined for predicting the pressure drop in eccentric annuli, and results are presented for 0, 64, and 90% eccentricities. (D.L.C.)

17058 (TID-12598) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. MONTHLY PROGRESS REPORT

FOR MARCH, 1961. Bruce Matzner (Columbia Univ., Engineering Research Labs.). Mar. 31, 1961. Contract AT(30-3)-187. 11p. (MPR-X-3-61)

Several runs to determine "burnout" conditions were made with the spirally wrapped 7-rod test section. Preliminary indications were that at low mass velocities ($\sim 5 \times 10^5$ lb/hr ft^2) and associated high exit steam qualities, the outer 6 rods run considerably hotter than the central rod. At higher mass velocities ($> 9 \times 10^5$ lb/hr ft^2) and the associated lower exit steam qualities, this was not the case. In these latter operating areas, temperature excursions were observed on the central rod while little evidence of overheating was found on the outer rods. In order to accommodate the NDA 19-rod test section, modification of the existing piping at the exit of the test section housing was started. Also included in these piping changes were provisions for running longer test sections with no alterations to existing piping. (auth)

17059 (WADD-TR-60-435) THE HOMOGENEOUS BOUNDARY LAYER AT AN AXISYMMETRIC STAGNATION POINT WITH LARGE RATES OF INJECTION. Paul A. Libby (Brooklyn. Polytechnic Inst.). Dec. 1960. Contract AF 33(616)-5944. 130p.

A theoretical analysis is presented of the boundary layer at an axisymmetric stagnation point with large rates of air injection. The results of a previous investigation indicated that for localized mass transfer in the stagnation region the rates of injection are considerably greater than those usually treated. The exact stagnation-point boundary-layer equations are integrated numerically for an approximate representation of the gas properties. The two point boundary conditions are treated in a new manner which is useful for various boundary-layer and mixing problems. The exact solutions indicate that for large rates of injection the boundary layer is closely represented by an inner isothermal shear flow and by an exterior relatively thin region in which the flow variables change to their free-stream values. An integral method based on profiles suggested by the exact solutions is developed and shown to lead to accurate predictions of the integral thicknesses which are of interest for a study of the downstream influence of the stagnation point mass transfer. (auth)

17060 THE GROWTH OF A BUBBLE OF VAPOUR MOVING IN A LIQUID HEATED THROUGHOUT ITS VOLUME. V. K. Zavoskii. Atomnaya Energ., 10: 272-4 (Mar. 1961). (In Russian)

An analysis is made of the kinetics of a boiling homogeneous reactor, and it is shown that the growth of a moving bubble in a volume-heated liquid at small heating load is determined by the rate of heat transfer from the surrounding liquid. (R.V.J.)

17061 HOW TO DESIGN FLUID-FLOW DISTRIBUTORS. D. R. Richardson (Union Carbide Chemicals Co., Institute, W. Va.). Chem. Eng., 68: No. 9, 83-6(May 1, 1961).

A design approach to the type of fluid flow distributor that operates by parallel flow through a number of orifices is presented. Design is based on the theory and experimental data on flow through orifices, and two assumptions that are sufficiently conservative to be accepted with reasonable confidence. Assume that the resistance to rearrangement will not exceed the friction loss that occurs when the total flow passes through the sudden enlargement from the inlet connection in the vessel, and that a ratio of

$$\frac{\text{flow resistance across each orifice}}{\text{rearranging resistance}} = 100$$

is enough to ensure equal flow through each orifice. (N.W.R.)

17062 GAS FLOW IN HEAT-EXCHANGE CHANNEL. I. I. Mazhirov. Izvest. Akad. Nauk S.S.S.R., Otdel, Tekh. Nauk, Mekh. i Mashinostr., No. 1, 102-6(Jan.-Feb. 1961). (In Russian)

A study was made of the effects of heat exchange on gas flow at subsonic and supersonic velocities. The difference was determined by analyzing one-dimensional flow of a completely nonviscous gas. (R.V.J.)

17063 IMPROVEMENTS IN TUBULOUS HEAT EXCHANGERS. Martin Charles Peters, Norman George Worley, and Anthony James Taylor (to Babcock & Wilcox, Ltd.). British Patent 865,427. Apr. 19, 1961.

A tubular heat exchanger comprising a cylindrical pressure vessel and a tube bank is designed for maximum utilization of the space within the pressure vessel. In this design, the pressure vessel is provided with a circumferentially extending set of thermal sleeves for the passage of tubes connecting end elements of the tube bank to a header outside the pressure vessel. (D.L.C.)

17064 MEANS FOR VISUALIZING FLUID FLOW PATTERNS. F. E. Lynch, L. D. Palmer, H. F. Poppendick, and G. M. Winn (to U. S. Atomic Energy Commission). U. S. Patent 2,984,744. May 16, 1961.

An apparatus is given for determining both the absolute and relative velocities of a phosphorescent fluid flowing through a transparent conduit. The apparatus includes a source for exciting a narrow transverse band of the fluid to phosphorescence, detecting means such as a camera located downstream from the exciting source to record the shape of the phosphorescent band as it passes, and a timer to measure the time elapsed between operation of the exciting source and operation of the camera.

Instrumentation

17065 (AD-244336) AN INVESTIGATION OF THE USE OF SEMICONDUCTORS AS DETECTORS OF NUCLEAR RADIATION (thesis). Edward Weber Ivy (Texas. Agricultural and Mechanical Coll., College Station). Aug. 1960. 61p.

An evaluation was made of commercially available semiconductors having suitable characteristics for radiation detectors. The study was concerned primarily with the detecting device rather than the design of associated electronic equipment. (B.O.G.)

17066 (AD-246473) A STUDY OF THE DYNAMIC CHARACTERISTICS OF THE TUNNEL DIODE AS AFFECTED BY ELECTRON BOMBARDMENT (thesis). Donald Lee Phillips (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1960. 54p.

Results of an investigation to determine the effects of electron bombardment on the dynamic negative resistance of tunnel diodes is presented. It was found that the negative resistance region of the diode decreases in extent and shifts toward lower bias levels while the diode is under bombardment. As the bombardment continues the permanent damage increases and the negative resistance region is entirely destroyed at an integrated dose of 10^{18} electrons. It was also found that circuit oscillations could not be restarted when the beam current reached a magnitude of 4 to 10 μa. Temperature annealing of the diode may recover its negative resistance region to some extent. (J.R.D.)

17067 (AERE-M-796) APPARATUS FOR DETERMINING THE MECHANICAL PROPERTIES OF ALPHA-ACTIVE MATERIALS. M. J. Notley and P. M. French (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 10p.

Apparatus for determining the hardness and tensile properties of plutonium alloys at temperatures up to 1000°C is described. (auth)

17068 (AERE-R-3630) IMPROVEMENTS TO THE CATHODE RAY POLAROGRAPH. J. E. Seaborn (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1961. 6p.

Methods of making accurate measurements with a cathode ray polorograph at high sensitivities when there is a rapid change of potential at a dropping mercury cathode are discussed. Circuits which compensate for the effects of cell capacity and of preceding reductions are described. A circuit for use in the examination of solutions with reversed potential sweep is also discussed. (M.C.G.)

17069 (AFCRL-TR-60-180) $Li^6I(Eu)$ NEUTRON SPECTROMETER. Final [Report]. Materials Engineering Report No. 6033-4801-A. J. C. Ritter, S. L. Ruby, and R. V. Babcock (Westinghouse Electric Corp. Air Arm Div., Baltimore). Aug. 15, 1960. Contract AF19(604)5617. 104p. (AD-244117)

$Li^6I(Eu)$ crystals were found to provide a reasonably convenient high efficiency, moderate resolution, absolute neutron energy spectrometer in the energy range above 1 Mev. Line shapes for monoenergetic neutrons were measured as a function of Eu doping and temperature. Voltage pulse height resolution of 12% for 4.9-Mev monoenergetic neutrons was obtained at liquid nitrogen temperature with a highly doped (0.15 mole%) Eu crystal. Information is presented on gamma-ray discrimination and the linearity between neutron energy and voltage pulse height. Such effects as light output pulse shape, light emission frequency, temperature, and crystal doping were considered. A design is given for a neutron energy spectrometer probe which operates at low temperatures. Methods for unscrambling neutron spectra are also given. (auth)

17070 (AFSWC-TR-60-60(IV)) PASSIVE INSTRUMENTATION, DASA PROJECTS 823 AND 833.4. VOLUME IV. Norman F. Harmon (American Science and Engineering, Inc., Cambridge, Mass.). Nov. 1960. Contract AF29 (601)-2322. 69p.

The design and operation of indent recorders (double pendulum and air gun systems) as impulse recording devices are treated. A series of high-explosive tests were conducted to determine the amount of energy that may safely be deposited in a confined volume and the amount of explosive that would not fail an indent recorder-casket geometry. The results are discussed. (D.L.C.)

17071 (CF-61-3-134) PNEUMATIC TEMPERATURE MEASURING SYSTEM. Progress Report. H. M. Hochreiter (Oak Ridge National Lab., Tenn.). Mar. 3, 1961. Contract [W-7405-eng-26]. 6p.

The transient response of the basic probe was calculated and verified by test results for the Marquardt probe. The effectiveness of divergent discharge sections in recovering static pressure at the nozzle discharge was evaluated. It was found that critical flow was maintained at ratios of downstream to upstream nozzle pressure as high as 0.8 to 0.85, whereas nozzles without divergent sections maintained critical flow only over pressure ratios of 0.5 or less. Two nozzles were accurately calibrated for use as flow standards. (D.L.C.)

17072 (DP-50(Del.)) THERMOCOUPLES AND CABLES FOR NUCLEAR REACTORS. J. M. Stone (Du Pont de Nemours (E. I.) & Co. Engineering Research Lab., Wilmington, Del.). Oct. 1953. Decl. with deletions Mar. 1, 1960. Contract AT(07-2)-1. 38p.

The development, design, specification, and manufacture of special-purpose thermocouples sheathed in stainless steel for use in reactors are described. A three-element cable for transmitting the signal from neutron-flux measuring devices was developed. (auth)

17073 (HW-67045) HANFORD WHOLE BODY COUNTER, 1959 ACTIVITIES. W. C. Roesch, R. C. McCall, and H. E. Palmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1960. Contract AT(45-1)-1350. 54p.

The Hanford whole body counter is a large NaI(Tl) scintillation counter in an iron room. There are special supporting facilities that permit counting large numbers of people as part of the radiation protection program. After completion early in 1959, a number of people were counted to establish average values of normal body radioactivity. The counter was also used to examine subjects who were suspected of being contaminated. The iron room was also used for measurements of plutonium in wounds. The largest amount of radioactivity, in terms of permissible amounts, found in any subject counted was 2.7% of the applicable permissible body burden. There were some cases of deposition of plutonium in wounds, but there is no accepted permissible body burden for this case with which to compare. Analysis of the data on normal body radioactivity shows that the results for K^{40}, a natural radioactivity, are quite close to those found elsewhere. The results for Cs^{137} are higher than any yet reported elsewhere but are consistent with the trend to higher values and with higher values in the northwestern part of the United States in particular. A new result is the discovery of Zn^{65} in nearly everyone counted. Isolated cases of Zn^{65} have been reported but no such wide-spread distribution such as found at Hanford. The amount of Zn^{65} in a subject is correlated with where he lives and works. Irrigation with Columbia River water containing water that has been used to cool the Hanford reactors results in the highest body burdens of Zn^{65}; there are relatively few of these people. Those subjects who live or work where drinking water is obtained from the Columbia River have higher body burdens than those who do not. One source of Zn^{65} for those not exposed through drinking water was found to be seafood, oysters in particular. Oysters harvested near the mouth of the Columbia River were later shown to be relatively high in Zn^{65} compared with oysters obtained elsewhere. The amounts of Zn^{65} not yet accounted for in the subjects examined are consistent with the amounts found in food in different parts of the United States. (C.H.)

17074 (NAA-SR-Memo-2825) CONTINUOUS SODIUM LEVEL INSTRUMENTS. G. E. Turner (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 4, 1958. 8p.

An attempt was made to verify the theory of operation of two types of continuous sodium level devices and to determine the optimum design parameters for each. The theory of operation of both types of level device was verified by various tests, with these tests also showing that an accuracy of better than ±1 in. is possible. The construction and testing of each instrument are recommended. (auth)

17075 (NASA-TR-R-98) HOT-WIRE CALORIMETRY: THEORY AND APPLICATION TO ION ROCKET RESEARCH. Lionel V. Baldwin and Virgil A. Sandborn (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). 1961. 85p.

A calorimeter probe (0.001 by 0.25 cm) for measuring

local power density in high-energy ion beams was studied theoretically and experimentally. For high sensitivity, the wire is heated by a detection current; the change in wire temperature due to ion impingement results in a voltage output. Both ion and joulean heat inputs are balanced by conduction along the wire to cooled supports. A steady-state calibration and error analysis is supported by experiment. Power-density measurements in 1- to 20-kilovolt cesium and mercury ion beams are presented as detailed spatial profile and contour maps. An analysis for the transient response of the hot-wire calorimeter was also verified by calibration experiments. (auth)

17076 (NP-10057) WIDE RANGE TACTICAL MONITORING INSTRUMENT IM-145(XE-1)/UD. Second Quarterly Progress Report, Period from October 15, 1960 to January 15, 1961. Report No. 2 [on] AN ENGINEERING STUDY TO DEVELOP A WIDE RANGE TACTICAL MONITORING INSTRUMENT (0.01 mf/hr to 500 r/hr) INCLUDING CONSTRUCTION OF FIFTEEN ENGINEERING TEST MODELS. E. J. DiIanni and F. C. Riggin (Nuclear Corp. of America. Instrument and Research Div., Denville, N. J.). Contract DA-36-039 SC-84932. 64p.

Activities during the period 15 October 1960 to 15 January 1961 are summarized. Included is the complete and revised circuit for the pilot test models under construction. This design was considered necessary when it was determined that material procurement lead-times for particular component parts of the previously advanced design would result in long delays in delivery of the pilot test models. The performance characteristics of the latest design are superior in many respects to the previous one. Supporting data for the breadboard instrument is included on battery life, temperature data on d-c and pulsed ranges, instrument accuracy to Co^{60}, circuit theory, energy dependence, life test on scale changing meter, and scale form factors. (auth)

17077 (NRL-4354) ANALYSIS OF SYSTEMS FOR THE RECORDING OF EXPONENTIAL SIGNALS. R. V. Talbot, J. R. Shipman, F. E. Huggin, and C. B. Dobbie (Naval Research Lab., Washington, D. C.). Mar. 15, 1954. Reprinted June 1960. 138p.

An analysis is presented of the requirements of a recording system to be used in recording single nonrecurrent signals of the form $Ke^{\alpha t}$ with the range of α being from approximately 1×10^8 to 20×10^8 sec^{-1}. Particular attention is given to the response of the more important system components such as detectors, transmission lines, signal amplifiers, and cathode-ray tubes. The capabilities and limitations of each are discussed. It is found that for a linear system the primary effect of each component is to cause a reduction in the relative amplitude of the signal, resulting in a reduction in the dynamic range of the system. Some attention is also given to the response of certain system elements to other type signals including impulse functions, step functions, ramp functions, and sinusoids. The effects of nonlinear elements are considered rather briefly. From this analysis conclusions are drawn and recommendations made concerning the selection of the most suitable system elements and the arrangement of these elements. (auth)

17078 (NRL-5523) DESIGN AND INSTRUMENTATION OF A POUND-WATKINS NUCLEAR MAGNETIC-RESONANCE SPECTROMETER. F. E. Geiger, Jr. (Naval Research Lab., Washington, D. C.). June 15, 1960. 39p. (AD-246974).

Problems of instrumentation of a Pound-Watkins nuclear magnetic-resonance spectrometer were investigated. Experimental data were collected for the sensitivity of the oscillator to a signal from a Watkins calibrator as a function of modulation frequencies from 30 cps to 5 kc and rf tank voltages from 0.05 to 0.7 v_{rms}. The results confirm Watkins' oscillator theory. An expression was derived for the amount of frequency modulation of the rf oscillator by the Watkins calibrator. For representative values of rf circuit components, this frequency modulation is roughly 0.5 cps at 10 Mc. The rf sample probes constructed for this project are almost free of modulation pickup in modulation fields as high as 23.5 oersteds (280 cps) and a steady field of 7000 oersteds. (auth)

17079 (OOR-2504:1) MEASUREMENTS IN IONIZED GASES USING THERMAL NEUTRON SCATTERING. Final Technical Report for period September 15, 1959 through August 31, 1960. Robert M. Delaney and Alfred H. Weber (Saint Louis Univ.). Mar. 10, 1961. Contract DA-23-072-ORD-1487. 8p.

The theory of a neutron thermometer for ionized gases is presented. The method is independent of the state of ionization of the gas. A preliminary exploratory experiment using an oxy-hydrogen flame and the neutron beam from the thermal column of the Argonne National Laboratory research reactor demonstrated the feasibility of the method. Further work is indicated. It is emphasized that the work is in its preliminary phase. (auth)

17080 (ORNL-2969) THE COSINE-CUBED NEUTRON SPECTROMETER (thesis). J. H. Thorngate, G. S. Hurst, F. J. Davis, and P. W. Reinhardt (Oak Ridge National Lab., Tenn.). May 3, 1961. Contract W-7405-eng-26. 56p.

Submitted to Vanderbilt Univ.

In an attempt to increase the efficiency, a proton recoil neutron spectrometer was built in which the proton detection crystal is in the shape of the surface formed by the rotation of the $\cos^3\theta$ curve about the $\theta = 0$ axis where θ is the angle between the direction of travel of the incident neutron and the direction of travel of the recoil proton. Such a construction makes the detector crystal conform to the range envelope of the protons recoiling from a neutron beam of sufficiently high energy into a gas in which the proton range is proportional to the 3/2 power of the proton energy. Sixteen pieces of thallium-activated cesium iodide were assembled as a mosaic arranged in the $\cos^3\theta$ shape so that the maximum θ was 30°. Calculations show that 25% of the protons recoil within 30°. The Po-Be and Po-B spectra were measured with the instrument using xenon in the chamber. The resolution of the spectra obtained was low due to nonuniform pulse height response of the CsI crystal sections and excessive gamma-ray response even though an anthracene proton radiator was used in a coincidence scheme designed to minimize gamma-ray background. The instrument did not exhibit the added efficiency which was being sought in the design. The necessity of single channel operation further limits its usefulness. (auth)

17081 (PG-Report-147) A DIRECT READING FLAME PHOTOMETER OF HIGH SENSITIVITY. A. Hinde (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1961. 28p.

The design and performance of a highly sensitive multichannel flame photometer which allows the simultaneous determination of up to four elements are described. The instrument is particularly intended for the routine determination of alkali and alkaline earth metal impurities in nuclear graphite, although it is of general application to flame photometric analysis. The photometer comprises an atomizer-burner unit, highly selective interference filters, and photomultipliers as detectors. Four optical channels are directed toward the common flame and the detector

output from each channel is integrated by means of an operational amplifier. Compensation for both flame background and the spectra of interfering elements is readily achieved within the instrument and the analysis element signal from each channel is presented on a direct-reading meter. A wide range of sensitivities is available. The most sensitive gives, for example, a full scale meter deflection from 0.05 μg/ml of lithium in solution. A typical analysis of graphite for lithium, sodium, and calcium is described. (auth)

17082 (TID-11869) 350 KILOVOLT PULSE VOLTAGE DIVIDER. M. Michael Brady (Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Jan. 1961. Contract AT(04-3)-21. Project Agreement No. 1. 44p. (M.L.-788; M-247).

A review of the most used high-voltage measurement schemes is presented. The capacitive voltage divider design is analyzed, and a measurement system using such a divider is described. Pulse information processing devices are examined and results of calibration and test of the divider are given. (J.R.D.)

17083 (TID-12467) SOLID STATE NEUTRON DETECTOR. First Quarterly Progress Report. (Brussels. Centre d'Etude de l'Energie Nucleaire). [1960]. 37p. AEC 203/Euratom 252

Discussions are given of the growing of p-n junctions in SiC and determining the properties: photocurrent, photovoltaic effect, and the capacity as a function of reverse bias. A description is given of a silicon surface barrier counter for α-particles. Radiation damage studies were made for the junctions by measuring the current-voltage characteristics during irradiation at temperatures to 500°C. (B.O.G.)

17084 (TID-12571) NANOSECOND DECAY TIME MEASUREMENTS. Milton Burton and Juan Yguerabide (University of Notre Dame, Notre Dame, Ind.). 1961. 28p.

Various techniques of luminescence decay measurement are reviewed briefly, and the repetitive time selection technique is treated in detail. A typical decay curve is presented for the system p-terphenyl–benzene which shows a long-decay-time tail. Evidence is presented for the viewpoint that the tail is real and characteristic of the scintillator system itself. The noise level originates in the image converter due to a steady state of gaseous conductivity being formed. An analytical treatment of luminescence decay curves is presented. At high scintillator solute concentrations, the decay is no longer simple first-order, and the domain and solute self-quenching mechanisms for explaining this result are discussed. (D.L.C.)

17085 (UCRL-6276) MINIMUM RISE TIMES OF CURRENT IN IGNITRONS. David B. Cummings (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 10, 1961. Contract W-7405-eng-48. 25p.

A pulse modulator switch was needed to carry currents beyond the ratings of the largest thyratrons and with a very rapid rise time. It also had to have a long life. Therefore, ignitrons were tested to determine their minimum current rise times. In these tests grided and ungrided tubes were used to short-circuit the coaxial cable pulse lines. The results showed ignitrons do not conduct current fast enough for the application. Tube temperature was confirmed to be the dominant parameter; circuit impedance and current had little effect in the ranges investigated. Several mechanisms which slow the current rise are discussed, and gas breakdown speed is concluded to be the limiting factor rather than tube inductance. (auth)

17086 (UCRL-6319) A SLOTTED-CYLINDER VELOCITY SELECTOR FOR NEUTRON RESEARCH. Myron Ruderman and William C. Dickinson (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 15, 1961. Contract W-7405-eng-48. 34p.

A slotted-cylinder neutron velocity selector was constructed and used at the Livermore Pool Type Reactor (LPTR) both as a neutron monochromator and as a high-pass neutron filter. The physical principles of the instrument that are relevant to these two applications are discussed. Transmission functions are given both for parallel and diverging beam geometry. Results of the measurement of the long wavelength spectrum of a neutron beam from the LPTR are presented. The problem of neutron coherent reflection from the slot walls of the instrument is discussed. (auth)

17087 (UCRL-9483) A PAPER TAPE TO MAGNETIC TAPE CONVERTER. Louis F. Flores (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 22, 1960. Contract W-7405-eng-48. 16p.

The Paper-Tape-to-Magnetic-Tape Converter consists of two racks of electronic equipment whose function is to transcribe seven-channel digital code on punched paper tape to seven-digital code on magnetic tape in a form compatible with the input requirements of the IBM 704 and 709 computers. Recording is accomplished by electronically controlling the "read" and "stop" modes of the paper tape reader while the magnetic tape continuously advances. The converter also checks for certain types of error in the structure of the coded information on the paper tape and indicates their presence. The encoded magnetic tape is used as the information input to a properly programmed IBM computer. (auth)

17088 (UCRL-9522) INSTRUMENTATION OF MULTICHANNEL COUNTING EXPERIMENTS. Frederick A. Kirsten and Dick A. Mack (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 4, 1961. Contract W-7405-eng-48. 28p.

Recent experience in instrumentation of several nuclear physics experiments demonstrated the feasibility of automating the data-acquisition phases of the experiment. Electronic circuits are employed wherever the rate of data flow would be slowed by the use of human operations. Information is selected, temporarily stored, and then recorded in a form suitable for immediate entry into a computer. Experimenters thus freed from the tedious aspects of data collection can devote their time to studying the results of the experiment. Potentially useful nuclear events are first selected by the fast-logic (10^{-8} sec) part of the instrumentation. Circuits performing simple logical functions are packaged in modular form for easy grouping into particular coincidence, gating, and mixing configurations. Circuits with slower response time (>10^{-6} sec) are used for temporary storage and recording operations. Automatic test routines are used to initially align the equipment as well as provide continuous calibration during the experiments. Some of the high-speed circuits are described as well as the methods used to incorporate them into a large counting system. (auth)

17089 (WAPD-RM-208(Del.)) OPERATIONAL CHARACTERISTICS OF NEUTRON DETECTING BORON THERMOPILES. William Baer (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Dec. 1953. Declassified with deletions May 4, 1960. Contract AT-11-1-GEN-14. 11p.

The operational characteristics of a boron thermopile for slow neutron detection were investigated. It was determined that the instrument is not useful as a neutron detector because of its low sensitivity to thermal neutrons

and its large response to variations in ambient temperature. (auth)

17090 (WAPD-T-823) CHECKING THE OPERATION OF A NUCLEAR COUNTING CHANNEL. Kenneth E. Relf (Westinghouse Electric Corp. Bettis Plant, Pittsburgh). Nov. 1957. Contract AT-11-1-GEN-14. 41p.

Quantitative criteria for judging the performance of a nuclear counting channel are discussed. Several procedures for evaluating the performance of the counting channels were combined with statistical tests of significance into one method or test. Statistical purity checks, comparison of actual and theoretical standard deviations, the Fisher variance test, and a chi-square test are described. (M.C.G.)

17091 (AEC-tr-4562) THE INTERFERENCE EFFECT IN THE MASS SPECTROMETER ION SOURCE. Rolf Taubert. Translated from Z. anal. Chem., 164: 164-81 (1958). 27p.

The interference effect in mass spectrometric analysis (deviation of gas mixture spectra from linear superposition of pure gas spectra) was investigated. Experiments with methane–butane mixtures show that the interference effect consists of a short-time effect and a long-time effect. The long-time effect was studied for a number of gas mixtures, and it was found that, while N_2, O_2, and saturated hydrocarbons show a reversible effect, 1-butene does not. The irreversible long-time effect of 1-butene is ascribed to a chemical transformation of the tungsten cathode, probably to tungsten carbide, while the reversible effect is due to absorption layers being deposited on the cathode with consequent alteration of the work function. In studies of the short-time effect, it was found to change its sign with the draw-out potential U_z and therefore is probably due to a change of the positive space charge by the additional gas. A pure gas was found to exhibit this small-time effect (self-interference) as expected, and the small-time effect is not affected by butenization, a common remedy for interference effects. The amounts of various gases giving the same small-time effect were calculated and found to give satisfactory agreement with experiment. The mechanism of the space charge and the relationship between characteristic lines and interference effects are discussed. (D.L.C.)

17092 (AERE-Trans-859) INVESTIGATION OF BF_3 PROPORTIONAL COUNTERS. H. F. Brinckmann and D. Gerber. Translated by E. Franklin from Kernenergie, 3: 309-14(1960). 13p.

The effects of gamma radiation on the counter plateau and the maximum permissible gamma dose rate as a function of the filling pressure are given. Experimental results indicate that the duration of life (L) is dependent on the gas amplification (M) in the equation $L \geqq 5 \times 10^{12}/M$. A method for determining gas amplification is given. (J.R.D.)

17093 (CEA-tr-R-547) EMPLOI DES FILMS PHOTOGRAPHIQUES POUR LE CONTRÔLE DOSIMÉTRIQUE INDIVIDUEL DES FLUX DE PARTICULES–BÉTA. (Use of Photographic Film for Individual Dosimetric Control of Flux of Beta Particles). N. S. Nikitin (I. S. Nikitine). Translated into French from Vestnik Rentgenol. i Radiol., 34: No. 4, 59-65(1959). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 3689.

17094 THE DEVELOPMENT OF NUCLEAR EMULSIONS. L. M. Barkov and D. M. Samoilovich. Doklady Akad. Nauk S.S.S.R., 136: 1059-62(Feb. 11, 1961). (In Russian)

The fine-grained fog whose rapid growth limits the development of nuclear emulsions is assumed to be due to the appearance of non-ionized microcrystals in the emulsion. Experiments on the development of emulsion P with an amidol developer shows that the number and dimensions of the non-ionized microcrystals increases with increasing time of development. If a development threshold is attained that corresponds to development of the main mass of microcrystals, Poisson statistics indicate that the occurrence of developed grains will take place very rapidly with further development. On comparing the experimental observations with the calculated results it can be assumed that the development of a fine-grained fog during prolonged development is due to the appearance of the main mass of non-ionized microcrystals of the emulsion. An analysis of the fluctuations occurring in the process of ionization and of the fluctuations in the number of traps gives a qualitative picture that explains the experimental results. (TTT)

17095 ABSOLUTE MEASUREMENT OF THE MEAN ENERGY ABSORBED IN THE FORMATION OF ION PAIRS WITH MONOCHROMATIC X-RAY OF 5.89 TO 17.44 KEV. D. Lang (Max-Planck-Institut für Biophysik, Frankfurt am Main). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed, 94: 528-39(Apr. 1961). (In German)

A method is described based on the use of the relationship $W = E/z$ which makes it possible to carry out the absolute measurement of the mean energy W absorbed in the formation of an ion pair with very soft x rays. The accuracy obtained is ±1.4%. The total energy absorbed $E = nE_q$ was found from the number n of monochromatic quanta of the energy E_q, which was produced with the help of a filter-difference method within the range from 5.89 to 17.44 kev. The number n was found with a scintillation counter containing a CsI (Tl) crystal of 1 mm thickness. Preliminary investigations proved that the counting was absolute. The number z of the ion pairs produced was measured with a totally absorbing ionization chamber. The required corrections were established. From the analysis of errors the constant value $W = (34.0 \pm 0.5)$ ev was found. (auth)

17096 AN ENTIRELY AUTOMATIC POINT COUNTING APPARATUS CONSTRUCTED FROM STANDARD SPECTROMETER X PARTS. Pierre Berge and Max Tournarie (Centre d'Etudes Nucleaires, Saclay, France). J. phys. radium, 21: Suppl. to No. 11, 181A-6A(Nov. 1960). (CEA-1655) (In French)

The apparatus described here permits the step by step study of a scattered beam of particles in terms of the scattering angle. It permits counting at a predetermined number of counts or at a fixed time, or mixed, the "time" being given either by a time base, or by a monitoring unit. The scattering angles are also recorded. (auth)

17097 DENSITY VS. EXPOSURE CURVES OF A PHOTOGRAPHIC EMULSION FOR 20 ~ 200 kV ELECTRONS. Mieko Takagi, Norihisa Kitamura, and Setsu Morimoto (Tokyo Inst. of Tech.). J. Phys. Soc. Japan, 16: 792-3(Apr. 1961). (In English)

Density (D)-Exposure (E) curves measured for Fuji Process Orthochromatic plates for electrons with energy 20 to 200 kv were given. The dependence of developing conditions on D-E curves was also examined. At a suitable developing condition, D-E curves for electrons with higher energy than 50 kv are linear over a wide range of density, and for electrons with lower energy they bend at lower density. (auth)

17098 THE HIGH-PRECISION ISOTOPIC ANALYSIS OF URANIUM HEXAFLUORIDE. J. Bishop, D. F. Davidson, P. B. F. Evans, A. N. Hamer, J. A. McKnight, and

E. J. Robbins (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). J. Sci. Instr., 38: 109-18(Apr. 1961). (DEG-Report-227)

Several factors limit the precision and accuracy which can be achieved in the isotopic analysis of uranium hexafluoride by a mass spectrometer. These include inadequate resolution, memory errors, statistical fluctuations in ion currents, amplifier noise, current noise, inefficient collection of ions, voltage coefficients in resistors and chemical contamination of samples. A description is given of a 90° sector field mass spectrometer of 30 cm radius, which is built and used to investigate the accuracy which can be achieved in practice. The precision (1 σ) of this instrument when measuring the fractional difference in isotope ratio between two samples is 5×10^{-5} at the 50% level of enrichment and 1.4×10^{-4} with natural uranium, for comparisons lasting 12 minutes. By suitable design of ion source and inlet system, the memory error in the measurement of the concentration difference between two samples is reduced to ±0.3% of the difference. (auth)

17099 SIMPLE MILLIMICROSECOND PULSE GENERATOR. H. S. Caplan and D. T. Stewart (Univ. of Glasgow). J. Sci. Instr., 38: 133(Apr. 1961).

A hydrogen discharge pulse generator is described, and an application of it to nuclear scintillation counter techniques is given. (auth)

17100 A RECORDING FLOWMETER USING A RADIOACTIVE FLOAT. D. W. Tims (Warren Spring Lab., Stevenage, Herts, Eng.). J. Sci. Instr., 38: 145-9(Apr. 1961).

An instrument of the type comprising a float in a vertical tapered tube is often suitable for measuring low rates of fluid flow but difficulties arise in obtaining remote indication, recording or control owing to the small physical size of the float and the consequent failure of conventional methods of detecting its position. A method in which a radioactivated float and low-voltage, high-current Geiger tubes are used to overcome these difficulties is described. (auth)

17101 TECHNIQUE USING ^{85}Kr-LABELLED KRYPTON FOR SURFACE AREA MEASUREMENTS. D. W. Aylmore and W. B. Jepson (Univ. of Exeter, Eng.). J. Sci. Instr., 38: 156-9(Apr. 1961).

A simple volumetric apparatus for the determination of the surface area of solid materials is described. Isotopically labelled krypton (Kr^{85}) is used as the adsorbate and the pressure measured using a combined counting cell and Geiger-Müller tube. The apparatus can be used to measure areas of 0.01 m^2 to 1 m^2 with a precision to 5% for 0.025 m^2, 1% for 0.1 m^2 and 1.5% for 1 m^2. (auth)

17102 A SIMPLE PLASMA OSCILLATOR. G. C. McCullagh (Queen's Univ., Belfast). J. Sci. Instr., 38: 164(Apr. 1961).

A simple and easily constructed plasma oscillator is described, giving power of the order of microwatts, and tunable over rather wide ranges, e.g. 40 to 55 cm, by varying the anode voltage. (auth)

17103 COUNTING LOSS AND SENSITIVITY OF GEIGER-MÜLLER TUBES. H. Gebauer (Frieseke & Hoepfner GmbH, Erlangen-Bruck, Ger.). Kerntechnik, 3: 130-2(Mar. 1961). (In German)

The counting loss occurring in work with G-M counters is explained by the dead time and the initial sensitivity of the counting apparatus. A suitable formula is given for the estimation of the sensitivity of G-M counters with respect to α, β, and γ radiation. (tr-auth)

17104 TRANSISTORS IN DIRECT CURRENT AMPLIFIERS. W. Guggenbühl (Contraves A. G., Zurich). Neue Tech., 3: No. 1, 31-43(Jan. 1961). (In German)

After a brief survey on the different methods of d-c amplification the problem of zero stability is treated in detail. The amplifiers are divided into two main groups, direct coupled types and chopper types. An equivalent circuit for d-c-drift in the active region of a transistor is shown, starting from the temperature dependence of characteristic d-c parameters. Remarks on aging are included. Some temperature compensated input stages with reduced drift are discussed. Different d-c amplifiers are compared using the equivalent drift power as a general measure for the performance of the circuits. An optimum source resistance for minimum drift power may be evaluated. The second part deals with chopper amplifiers. Transistor switching characteristics are compared with those of an ideal switch. Temperature variations of these characteristics and some circuit aspects of transistor choppers are discussed. In the last part the zero stability obtainable with these circuit techniques is tabulated for some typical input stages. (auth)

17105 CHOOSING A METHOD FOR COUNTING SOFT BETAS. David R. Christman (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 19: No. 5, 51-5; 64 (May 1961).

Methods are described for counting soft β emission from gases, liquids, and solids. It is suggested that G-M tubes or proportional detectors be used for solids, ionization chambers or proportional detectors for gases, and scintillation methods for liquids. A comparison is given of the precisions, sensitivities, intensity limits, and costs of each of these types of instruments, for either C^{14} or H^3 measurements. Counting with S^{35} is discussed. (T.F.H.)

17106 OZONE ANALYZER USES RADIOACTIVE CLATHRATE. Carlton O. Hommel, David Chleck, and Frederick J. Brousaides (Tracerlab, Waltham, Mass.). Nucleonics, 19: No. 5, 94; 96; 98; 100; 102(May 1961).

An ozone detector is described in which a dried gas containing O_3 flows over a quinol clathrate containing Kr^{85}. The reaction $(quinol)_3 . Kr^{85} + O_3 \rightarrow 3$ quinone $+ 3H_2O + Kr^{85}$ releases an amount of Kr^{85} proportional to the original O_3 concentration. The potential sensitivity of the device is several parts in ten billion. (T.F.H.)

17107 THE CHOPPER WITH CURVED SLOTS. Heinz Teutsch (Institut für Atomphysik, Bucharest). Nukleonik, 3: 15-26(Mar. 1961). (In German)

The physical parameters of choppers with curved slots for thermal and subthermal neutrons were investigated, and the corresponding equations were derived. The ideal form of the slot and the most effective approximation with curves were determined. The transmission function, the resolution power, and the best flight path were derived, and the relative zero effect was more accurately investigated with thermal and epithermal neutrons. The equations derived permit the selection of the most suitable constants for the construction of a given chopper and the best research conditions. These equations can also be used in choppers for higher neutron energies and with other slit arrangements. For the chopper with cigar-shaped slits, the corresponding equations were derived. (tr-auth)

17108 ON THE TIME-DELAY PROBABILITY FUNCTION OF THE PULSES OF CO_2-CS_2 G-M COUNTERS. Wlodzimierz Moscicki and Henryk Renk (Inst. of Nuclear Research, Warsaw and Danzig Polytechnic Inst.). Nukleonika, 5: 811-20(1960). (In Polish)

Attempts at determining the time-delay probability function of pulses of $CO_2 + CS_2$ G-M counters were performed. One was based on the results obtained by Móscicki for the change in number of the counter-shielding anticoincidences as a function of the delay time of the shielding signals; the

other for the change of the number of the threefold coincidences of the telescope: argon-alcohol, $CO_2 + CS_2$, argon-alcohol G-M counters as a function of the delay-time of the doublefold coincidences of the two argon-alcohol G-M counters. On the basis of the results obtained the constants of the function of the time-delay probability of the form $\Phi(t) = ke^{-\lambda t}$ were evaluated as $k = 0.68 \pm 0.06$ and $\lambda = (0.45 \pm 0.05) 10^5 \text{ min}^{-1}$.

17109 A HUNDRED CHANNEL AMPLITUDE ANALYZER. Ryszard Bayer, Jerzy Chmielewski, and Teresa Koba (Inst. of Nuclear Research, Academy of Sciences, Warsaw). Nukleonika, 5: 881-6(1960). (In Polish)

The design, specifications and performance of a 100-channel amplitude analyzer are described. (R.V.J.)

17110 A POLYACRYLAMIDE GAMMA DOSIMETER. A. L. Boni (E. I. du Pont de Nemours and Co., Aiken, S. C.). Radiation Research, 14: 374-80(Apr. 1961).

A simple chemical dosimeter is described which is based on the degradation of polyacrylamide of x and γ radiation. The sensitivity range is between 50 and 7500 r and is essentially unaffected by fast and thermal neutron fields. The dosimeter is dose-rate- and energy-independent, is stable over long periods of time before and after irradiation, and is simple to make and read. Additionally, it is suited for inclusion in a multipurpose foil dosimeter to be employed for personnel monitoring in criticality incidents. (auth)

17111 A SMALL AND INEXPENSIVE ULTRAVIOLET DOSE-RATE METER USEFUL IN BIOLOGICAL EXPERIMENTS. John Jagger (Oak Ridge National Lab., Tenn.). Radiation Research, 14: 394-403(Apr. 1961).

A dose-rate meter, useful in biological experiments in which germicidal or black light lamps are used, is described. It consists of a photovoltaic cell, a filter, a holder, and a microammeter. For many experimental situations, it has the advantages over existing devices of very small size, low cost, ease of assembly, and usefulness for the near as well as the far ultraviolet. (auth)

17112 SCINTILLATION TECHNIQUES IN ESTIMATING NATURAL RADIOCARBON AND THEIR APPLICATION FOR DETERMINING THE ABSOLUTE AGE. I. E. Starik, V. P. Shamov, Kh. A. Arslanov, A. P. Zharkov, and G. M. Murashov. Radiokhimiya, 3: No. 1, 101-13(1961). (In Russian)

A liquid-scintillation method was developed for estimating natural radiocarbon. The utilization of a highly-efficient coincidence counter and liquid benzene and ethyl benzene scintillators, synthesized with carbon according to a given scheme, permits estimations of absolute age up to 37000 years in ethyl benzene and up to 48000 years in benzene. (R.V.J.)

17113 NEUTRON DOSIMETRY FOR MATERIALS IRRADIATION STUDIES. L. E. Steele and J. R. Hawthorne (U. S. Naval Research Lab., Washington, D. C.). p.111-26 of "Radiation Effects and Radiation Dosimetry. Special Technical Publication No. 286." Philadelphia, American Society for Testing Materials, 1960.

The correct interpretation of radiation effects upon materials depends upon accurate knowledge of neutron exposures. An analysis of the problems associated with neutron dosimetry for materials irradiation experiments in research reactors is presented along with a discussion of neutron flux data as a factor in the experimental environment. Some of the problems presented include: choosing the best monitors, interpreting preliminary neutron flux surveys, measuring and interpreting flux levels under changing reactor conditions, and using flux data in the analysis of radiation effects. These problems are discussed, citing examples from practical experience in the Argonne CP-5 Reactor, the Brookhaven Graphite Reactor, the Oak Ridge Low-Intensity Test Reactor (LITR), and the Materials Testing Reactor (MTR). (auth)

17114 BEAM MONITORING METHODS. PART I. MONITORING HIGH-ENERGY PROTON BEAMS. D. O. Caldwell (Massachusetts Inst. of Tech., Cambridge). PART II. MONITORING HIGH-ENERGY ELECTRON AND X-RAY BEAMS. G. S. Janes (Avco Research Lab., Everett, Mass.). p.487-520 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

Monitoring methods for proton, electron, and x-ray beams are described. Both relative and absolute proton monitoring devices are studied. In monitoring energetic electrons or x rays, bremsstrahlung and pair production caused by interactions with nuclear Coulomb fields must be included in the total effect. Methods for determining electron and x-ray beam spectra are given. (T.F.H.)

17115 IMPROVEMENTS IN OR RELATING TO A METHOD AND APPARATUS FOR THE CONTINUOUS MEASUREMENT OF THE RADIOACTIVITY OF SUBSTANCES IN A LIQUID. (to Landis & Gyr A. G.). British Patent 865,603. Apr. 19, 1961.

An apparatus is designed for measuring the activity of low-activity liquids. In the apparatus, the liquid is fed to a uniformly moving strip of absorbent material, e.g., filter paper, the liquid is evaporated by a heating device, and the resulting spot is counted under a radiation detector. (D.L.C.)

17116 ELECTRONIC BIVANE WIND DIRECTION INDICATOR. Harry Moses (to U. S. Atomic Energy Commission). U. S. Patent 2,983,144. May 9, 1961.

An apparatus is described for determining and recording three dimensional wind vectors. The apparatus comprises a rotatably mounted azimuthal wind component sensing head and an elevational wind component sensing head mounted to the azimuthal head and adapted to rotate therewith in the azimuthal plane and independently in the elevational plane. A heat source and thermocouples disposed thereabout are mounted within each of the sensing heads, the thermocouples providing electrical signals responsive to the temperature differential created by the passage of air through the sensing tubes. The thermocouple signals are applied to drive mechanisms which position the sensing heads to a null wind position. Recording means are provided responsive to positional data from the drive mechanisms which are a measurement of the three dimensional wind vectors.

17117 SPECIFIC HEAT INDICATOR. F. L. Horn and J. E. Binns (to U. S. Atomic Energy Commission). U. S. Patent 2,983,145. May 9, 1961.

Apparatus for continuously and automatically measuring and computing the specific heat of a flowing solution is described. The invention provides for the continuous measurement of all the parameters required for the mathematical solution of this characteristic. The parameters are converted to logarithmic functions which are added and subtracted in accordance with the solution and a null-seeking servo reduces errors due to changing voltage drops to a minimum. Logarithmic potentiometers are utilized in a unique manner to accomplish these results.

17118 RADIO RANGING DEVICE. Robert T. Nieset (to U. S. Atomic Energy Commission). U. S. Patent 2,984,833. May 16, 1961.

A radio ranging device is described. It utilizes a super-

regenerative detector-oscillator in which echoes of transmitted pulses are received in proper phase to reduce noise energy at a selected range and also at multiples of the selected range.

Materials Testing

17119 (AID/MET/28(Suppl.)) AN EXTENSOMETER WITH CAMERA ATTACHMENT FOR HIGH SENSITIVITY CREEP TESTS. E. G. Webster and F. J. Tranter (Gt. Brit. Ministry of Aviation. A.I.D., Harefield, Middx., England). Oct. 1960. 11p.

A method for recording the creep extension of test samples by using a Marten's type optical lever extensometer and an automatic camera was previously described. Improvements to the photographic recording unit and the use of a roller type optical lever extensometer to replace the Marten's type are discussed. The modifications to the original unit made it more flexible and resulted in a clearer image with greater depth of focus. It was found to be very easy to fit the roller type extensometer to a ridged type test piece and no suggestion of slip of the rollers was found. Repeat readings of the order of ± ¼ mm were obtained. (M.C.G.)

17120 (TID-10167(Del.)) THE BURSTING TEST METHOD AND ITS APPLICATION IN TESTING HAPO URANIUM FUEL ELEMENTS. L. D. Schaffer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 30, 1954. Decl. with deletions Feb. 16, 1960. Contract W-31-109-eng-52. 29p.

The bursting tests were initiated to evaluate the mechanical properties of various fuel element materials in their production configuration and to determine the effects of any material imperfection on the properties. Internal pressure is applied to the interior of a cored fuel element by the application of load to a center core of lead. The lead under pressure flows plastically and transmits the applied pressure to the specimen wall. Loading is continued until the specimen wall fails. Specimen deformation readings are taken during the test. The data obtained are used to interpret the type and evaluate the quality of material tested. (auth)

17121 RADIOACTIVE RING WEAR TESTING IN RAILROAD DIESEL LOCOMOTIVES. C. F. Jursch (Southern Pacific Co., San Francisco), P. L. Pinotti, and D. R. Jones. p.3-14 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

The radioactive tracer technique has proved to be an excellent tool for investigating a wide variety of factors that influence ring wear in railroad diesel locomotives. The method can be utilized with equal success in both two- and four-stroke cycle railroad diesel engines. With proper monitoring and safety supervision, radioactive piston ring tests can be run in diesel locomotives without undue hazard to operating and maintenance personnel. Considering the rapidity with which data can be obtained, the test technique gives remarkably good precision in both two- and four-stroke cycle engines. Maximum test accuracy is obtained by installing activated rings in all power assemblies. (auth)

17122 GRAIN BOUNDARY SEGREGATION STUDIES BY ACTIVATION. Warner W. Schultz (General Electric Co., Schenectady, N. Y.). p.15-19 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

A new technique developed to gain information on the elemental structure of segregation at grain boundaries consists of activating the specimen and electropolishing the fractured surface in small increments. The fracture is along the grain boundaries. The induced activity of the dissolved metal in the etchant gives a quantitative measure of the elements present. The technique should be equally applicable to the study of the diffusion of one element into another or to the study of surface phenomena. The first measurements made of the segregation of manganese and chromium into the grain boundaries of the steel used in turbine forgings is described. (auth)

17123 NONDESTRUCTIVE EDDY CURRENT TESTING. Claus J. Renken, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,985,824. May 23, 1961.

An eddy current testing device is described for measuring metal continuity independent of probe-to-sample spacing. An inductance wound test probe is made a leg of a variable impedance bridge and the bridge is balanced with the probe away from the sample. An a-c signal is applied across the input terminals of the bridge circuit. As the probe is brought into proximity with the metal sample, the resulting impedance change in the probe gives an output signal from the bridge whose phase angle is proportional to the sample continuity and amplitude is proportional to the probe-to-sample spacing. The output signal from the bridge is applied to a compensating network where, responsive to amplitude changes from the bridge output signal, a constant phased voltage output is maintained when the sample is continuous regardless of probe-to-sample spacing. A phase meter calibrated to read changes in resistivity of the metal sample measures the phase shift between the output of the compensating network and the original a-c signal applied to the bridge.

GEOLOGY, MINERALOGY, AND METEOROLOGY

17124 (RME-3111) RESEARCH AND DEVELOPMENT OF GEOPHYSICAL AND GEOCHEMICAL TECHNIQUES FOR URANIUM EXPLORATION ON THE COLORADO PLATEAU. Final Report, June 1953 to June 1954. (Research, Inc., Dallas). May 1955. Contract AT(30-1)-1542. 98p.

A survey was made of geophysical and geochemical methods and techniques which might prove effective aides in exploring for uranium. The effectiveness of the methods was appraised by the results of field surveys in areas about to be drilled or in areas where ore was known to exist. Model studies were conducted in the laboratory, preliminary to field tests, of certain electrical prospecting methods. Conclusions and recommendations are included. Methods discussed include field investigations, radiometric surveying, electrical tank experiments, electrical field investigations, seismic investigations, drill hole logging, induction logger development, soil investigation, geochemical studies, and the statistical design of an exploration net. A bibliography was compiled, listing approximately 410 references to papers and publications concerned with geophysical prospecting methods for uranium. (C.H.)

17125 (TID-11851) RADIOACTIVE FALLOUT DATA 1959. Collected from Ten AEC Installations. Alfred W. Klement, Jr., ed. (Division of Biology and Medicine, AEC). May 1960. 110p.

Data are summarized on fall-out at 10 atomic energy installations in the U.S. during 1959. Local situations at each installation dictated the use of different sampling and reporting systems involving a variety of equipment and methods. (C.H.)

17126 (TID-12439) BIOENVIRONMENTAL FEATURES OF THE OGOTORUK CREEK AREA, CAPE THOMPSON, ALASKA. A First Summary by The Committee on Environmental Studies for Project Chariot. (Division of Biology and Medicine, AEC). Dec. 1960. 74p.

Results are summarized from more than 30 bioenvironmental investigations carried out in the Cape Thompson area in Alaska since 1959. Data are included on geology and soils, plants and animals, weather and climate, radiological analyses, biogeography, ecology, archaeology, and indigenous human populations. The environmental studies were conducted in conjunction with a proposed excavation project using nuclear explosives (Project Chariot, Plowshare Program). (C.H.)

17127 (TID-12543) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Quarterly Progress Report, December 1, 1960 through February 28, 1961. (Rice Univ., Houston, Tex.). For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract 1491. 10p.

Studies were made of the thorium content of the Conway granite of New Hampshire. The single channel, vacuum tube pulse height analyzer was replaced by a 256 channel, transistorized instrument that improved the accuracy and speed of the radiometric determination of thorium in rocks. A transistorized portable instrument is also being constructed. It was concluded that the thorium in the Conway granite is very heterogeneously distributed and that these samples are hard to homogenize. The α activity of Brazil nuts was studied as part of an investigation of the thorium content of laterites. (M.C.G.)

17128 (TID-12545) PREDICTION OF UPWIND FALLOUT FROM NUCLEAR DETONATIONS IN THE MEGATON RANGE. Gilbert J. Ferber (Weather Bureau, Washington, D. C.). June 1960. 18p.

A simple method is presented for predicting the pattern of radioactivity deposited on the ground upwind following a large nuclear detonation. The method incorporates the effects of wind speed in order to better approximate the actual upwind fall-out. It is suggested that the upwind prediction scheme can be adapted to Civil Defense requirements to achieve a reasonable and usable estimate. (C.H.)

17129 (TID-12612) TRITIUM CONTENT OF RAINWATER FROM THE EASTERN MEDITERRANEAN AREA. Joel R. Gat, Uriel Karfunkel, and Aharon Nir (Weizmann Inst. of Science, Rehovoth, Israel). [1961]. Contract AT (30-1)-2166. 28p. (TTS/16)

Investigations were made on the tritium content of rain water to trace the circulation of tritium in the atmosphere following its injection by thermonuclear explosions. Data are tabulated on the tritium content of samples from Israel and other Eastern Mediterranean countries collected during 1958, 1959, 1960, and through Jan. 1961. Meteorological factors affecting the tritium levels in rain water in this area are discussed. (C.H.)

17130 (UCRL-6241) LRL-NEVADA DRILL HOLE SURVEY TECHNIQUE. Arthur L. Anderson, Lester P. Skousen, and Walter P. Bennett (California. Univ., Mercury, Nev. Radiation Lab.). Dec. 1960. Contract W-7405-Eng-48. 32p.

The demands of the scientific programs of the Lawrence Radiation Laboratory of the Nevada Test Site necessitated the development of special drill hole survey techniques. These techniques, in general, made possible the attainment of greater survey accuracies than are ordinarily obtained by the drilling industry in the course of normal survey work. For drill holes requiring a moderately high degree of location accuracy, standard survey equipment, manufactured by the Eastman Oil Well Survey Company was adapted by LRL to meet this need. Where an extremely high degree of survey accuracy and control of drilling effort was necessary, such as in the drilling and survey of line-of-sight holes, special optical equipment was developed. The modifications of equipment, refinements in procedures, and special techniques necessary to adapt this equipment to meet the more demanding accuracy requirements of the scientific programs are discussed. The over-all techniques of survey, equipment used, and the accuracies obtained together with results of completed surveys showing a comparison with standard land survey methods are also discussed and illustrated in some detail. (auth)

17131 (SCL-T-362) CONTRIBUTION TO THE STUDY OF SOUND DAMPING (ATTENUATION) IN THE FREE ATMOSPHERE. M. Jorand. Translated by Marcel I. Weinreich from J. mecan. et phys. atmosphere, 1: No. 1, 43-7 (Jan.-Mar. 1959). 7p.

Methods for calculating damping coefficients of sound similar to those found experimentally are discussed. Theories of damping brought about by the thermal conductivity of the air, the viscosity of the air, thermal radiation, and the activation of air molecules gave values definitely smaller than the coefficients observed empirically. The effects of air turbulence on the propagation of sounds in free atmosphere were therefore investigated. It was found that the introduction of a coefficient of turbulent

viscosity, variable with the scale considered, gave theoretical results in agreement with those obtained experimentally. (M.C.G.)

17132 THE TERTIARY INTRUSIONS OF THE ISLE OF ELBA. G. Marinelli (Consiglio Nazionale delle Ricerche, Rome). Atti soc. toscana sci. nat. Pisa. Mem. Ser. A, 66: 50-253(1959). (In Italian)

A geologic and petrographic study is made of the numerous lithologic types which constitute the two tertiary intrusions of the Isle of Elba, that of Monte Capanne in the west and that of Porto Azzurro in the south east. After a review of the results of methodological investigations by granulometry and modal analysis, the results of special studies, such as the chemical analysis of certain mineral constituents, the specific radioactivity of zircons and uraninite contained in some samples, and the total concentration of uranium in various lithological types, are given. The work is concluded by some considerations on the chemism of the rocks studied, on the genesis of the intrusive massifs, of the filons, and of the enclaves, and on the age of these intrusions. These considerations are made within the general framework of the actual knowledge of the geology of the orogenesis of the Appenines. (tr-auth)

17133 PRACTICAL MEASUREMENT OF THE ABILITY OF SOILS TO RETAIN RADIOELEMENTS. J. Bourrier, P. Bovard, and A. Grauby. Compt. rend. acad. agr. France, 46: 349-52(1960). (CEA-1557) (In French)

A method for studying the behaviour of radioelements in soils subjected to radioactive submersion of rain is presented. This method is based on two operations: evaluation, by counting, of the residual radioactivity of the eluates; localization by autoradiography of the radioactivity in the mass. Results, obtained on soils in position which have retained their main parameters, allow a rapid deduction of the path of the ions and the chances of contamination of the sub-soil or the water table. (auth)

17134 DATING OF OCEAN SEDIMENTS. D. P. Kharkar, D. Lal, N. Narsappaya, and B. Peters (Tata Inst. of Fundamental Research, Bombay). Compt. rend. congr. assoc. sci. pays Ocean Indien, 3, Tananarive, 1957. Sect. C., 39-42(1958). (In English)

The variation of cosmic ray intensity and the sedimentation rates in the past can be determined under either of the following conditions: If the titanium deposition, in addition to being uniform in space, has remained constant in the past, then the titanium concentrations yield the sedimentation rate and therefore the age of the various sediment layers. The Be^{10} concentrations then determine the cosmic ray intensities at various ages. If the cosmic ray intensity has varied linearly with time, the total Be^{10} contents of a long core together with the present day deposition rate of Be^{10}, yields the cosmic ray intensity as a function of time. Be^{10} concentrations at any particular depth then determine the sedimentation rate and the rate of deposition of titanium. The results of these two methods are presented. (N.W.R.)

17135 KINETICS AND THERMOLUMINESCENCE IN GEOCHEMISTRY. Farrington Daniels (Univ. of Wisconsin, Madison). Geochim. et Cosmochim. Acta, 22: 65-74(Mar. 1961).

A discussion of theoretical chemical kinetics with application to the calcite-aragonite problem and a laboratory technique on the thermoluminescence of crystals are presented. (N.W.R.)

17136 AGE MEASUREMENTS ON PEGMATITES AND A BASIC CHARNOCKITE LENS OCCURRING NEAR LÜTZOW-HOLM BAY, ANTARCTICA. L. O. Nicolaysen (Bernard Price Inst. of Geophysical Research, Johannesburg), A. J. Burger, T. Tatsumi, and L. H. Ahrens. Geochim. et Cosmochim. Acta, 22: 94-8(Mar. 1961).

Rb^{87}–Sr^{87} age measurements were carried out on large biotite crystals from three granitic pegmatites and a basic charnockite lens occurring near Lützow–Holm Bay, Queen Maud Land. The mean age obtained (~515 million years) probably refers to the last major metamorphic episode in this region. The age data are also significant for the interpretation of palaeomagnetic results reported from this area. (auth)

17137 STABLE CARBON ISOTOPE STUDIES OF CRUDE OILS AND THEIR PORPHYRIN AGGREGATES. R. Park (California Inst. of Tech., Pasadena) and H. N. Dunning. Geochim. et Cosmochim. Acta, 22: 99-105(Mar. 1961).

The C^{13}/C^{12} ratios of several crude oils and porphyrin aggregates isolated from them are given. These data show that the δ-values for the crude oils analyzed in this study fall within the ranges reported by Silverman and Epstein and that the C^{13}/C^{12} ratios of all the relatively pure porphyrin aggregates are from 4 to 5 per mil greater than the C^{13}/C^{12} ratio of the crude oils from which they were extracted. Hence, the porphyrin aggregates from crude oils are generally enriched in C^{13} with respect to the petroleum hydrocarbon. These data indicate that the porphyrins from these petroleums were present during the formation and digensis of the oil. (N.W.R.)

17138 THE DIFFUSION OF HELIUM THROUGH SEDIMENTARY ROCKS. R. Newton and G. F. Round (Research Council of Alberta, Edmonton, Can.). Geochim. et Cosmochim. Acta, 22: 106-32(Mar. 1961).

Helium is produced by the radioactive decay of the nuclides of certain minerals and it is commonly assumed that a portion of this helium migrates from its source through overlying rocks to the atmosphere. In this paper the effect of diffusion control on the migration of helium in sediments is evaluated by the construction of a series of mathematical models to represent a wide range of practical situations. These models range from that with a single infinite, uniform layer of sediment to that with n different, finite uniform layers of sediments. The problem is reduced to one-dimensional diffusion with the Pre-Cambrian basement rocks as the source of helium and the diffusion equation is solved for this system with differing boundary conditions. The n-layer models are evaluated by a series of suitable approximations at each of the interfaces between the layers and in this way the relationship between the helium concentrations in successive layers is obtained. The effect of these approximations is illustrated by using them to evaluate some of the single-layer models. Some of the single-layer and two-layer models are evaluated using representative values for the parameters introduced in the analysis. (auth)

17139 GRAPHIC AND ALGEBRAIC SOLUTIONS OF THE DISCORDANT LEAD–URANIUM AGE PROBLEM. L. R. Stieff and T. W. Stern (U. S. Geological Survey, Washington, D. C.). Geochim. et Cosmochim. Acta, 22: 176-99(Mar. 1961).

The calculation of the possible concordant ages from discordant age data is greatly simplified by graphical methods of plotting the mole ratios of radiogenic Pb^{206}/U^{238} (N_{206}/N_{238}) vs. radiogenic Pb^{207}/U^{235} (N_{207}/N_{235}) after correcting for the contaminating common Pb^{206} and Pb^{207}. The linear relationships noted in this graphical procedure are extended to plots of the mole ratios of total Pb^{206}/U^{238} ($^tN_{206}/N_{238}$) vs. total Pb^{207}/U^{235} ($^tN_{207}/N_{235}$). This modification per-

mits the calculation of concordant ages for unaltered samples using only the Pb^{207}/Pb^{206} ratio of the contaminating common lead. If isotopic data are available for two samples of the same age, x and y, from the same or related deposits or outcrops, graphs of the normalized difference ratios

$$\left[\frac{(N_{206}/N_{204})x - (N_{206}/N_{204})y}{(N_{238}/N_{204})x - (N_{238}/N_{204})y}\right] \text{ vs. } \left[\frac{(N_{207}/N_{204})x - (N_{207}/N_{204})y}{(N_{235}/N_{204})x - (N_{235}/N_{204})y}\right]$$

can give concordant ages corrected for unknown amounts of a common lead with an unknown Pb^{207}/Pb^{206} ratio. (If thorium is absent the difference ratios may be normalized with the more abundant index isotope, Pb^{208}.) Similar plots of the normalized difference ratios for three genetically related samples (x – y) and (x – z) will give concordant ages corrected, in addition, for either one unknown period of past alteration or initial contamination by an older generation of radiogenic lead of unknown Pb^{207}/Pb^{206} ratio. The algebraic equivalents of these new graphical methods give equations which may be programmed for computing machines. For geologically probable parameters the equations of higher order have two positive real roots that rapidly converge on the exact concordant ages corrected for original radiogenic lead and for loss or gain of lead or uranium. Modifications of these general age equations expanded only to the second degree are derived for use with desk calculators. These graphical and algebraic methods clearly suggest both the type and minimum number of samples necessary for adequate mathematical analysis of discordant lead isotope age data. This mathematical treatment also makes it clear that discordant lead isotope data alone cannot provide the basis for the choice of one of the possible concordant age solutions. (auth)

17140 CONTRIBUTION TO THE GEOCHEMISTRY OF TANTALUM AND NIOBIUM IN THE HYDROTHERMAL-PNEUMATHOLYTIC PROCESS. A. A. Beus and A. A. Sitnin (Inst. of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, Academy of Sciences, Moscow). Geokhimiya, No. 3, 209-14(1961). (In Russian)

Data obtained as a result of geochemical investigations show that tantalum and niobium are typical elements of high-temperature postmagmatic processes (early albitization, greysening) connected with granites. The separation of tantalum and niobium in the hydrothermal-pneumatholytic process (greysening stage), which leads to the concentration of tantalum in albitized and greysenized granites (40 to 100 times compared to the average content in granites) is connected with the different mobility and stability of their acido-complex compounds (in particular fluor- and oxyfluor-complexes), the existence of which in greysening solutions is suggested. A natural analogy in the behavior of both elements in the processes of postmagmatic metasomatose in granites and granitic pegmatites is suggested. (tr-auth)

17141 ON THE PRODUCTION OF RADIOISOTOPES IN THE ATMOSPHERE BY COSMIC RADIATION AND THEIR APPLICATION TO METEOROLOGY. D. Lal, P. K. Malhorta, and B. Peters (Tata Inst. of Fundamental Research, Bombay). J. Atmospheric and Terrest. Phys., 12: 306-28 (1958).

Cosmic radiation produces various radioisotopes in the atmosphere which are efficiently collected during the condensation of moisture and can be detected in rain water. The production rates of various radioisotopes, mainly those whose half lives make them suitable for studying meteorological phenomena, have been calculated for all parts of the atmosphere and are presented in graphical form. For the isotope, Be^{10}, whose half life is long compared to the characteristic time of mixing between the stratosphere and the troposphere, the fall-out rate agrees with the calculated production rate. For the isotopes, Be^{7}, P^{33}, and P^{32}, whose half lives are short compared to the characteristic time of mixing between the stratosphere and the troposphere, the measured fall-out rates agree with the calculations, provided one assumes that only the activity produced in the troposphere appears in rain-water and contributions from air irradiated in the stratosphere are comparatively rare, and that the mean period, between successive removals of radioisotopes from air masses, is about 1 month. Tentative measurements on the fall-out of S^{35} activity indicate an appreciably higher rate than calculated. It is shown that the relative concentrations of any two radioisotopes with appreciably different half lives, in a particular rain, do not depend on the local meteorological conditions, but only on the latitude and altitude at which the air mass was irradiated and can therefore be used as labels to trace the history of air-masses. The study of such isotope ratios in individual precipitations can, therefore, lead to useful meteorological information. (auth)

17142 NATURAL RADIOACTIVITY IN WEST DEVON WATER-SUPPLIES. John D. Abbatt, J. R. A. Lakey, and D. J. Mathias. Lancet, 2: 1272-4(Dec. 10, 1960).

Wide variations in the natural radioactive content of water supplies have been demonstrated in West Devon and elsewhere. Unexpected variations in cancer incidence, apparently related to water supplies, have also been reported in West Devon. An intensive program of measurement of radioactivity and a social survey is now being conducted in West Devon to try to define the extent of individual exposure in the area to radiation and to any other agents in the water, and to relate this exposure to any effects that may be produced. (auth)

17143 EFFECT OF AGING ON FIXATION OF STRONTIUM 90 BY SOILS. R. K. Schulz and H. H. Riedel (Univ. of California, Berkeley). Soil Sci., 91: 262-4(Apr. 1961).

With the passage of several years a small fixation of Sr^{90} was found to exist in a nonexchangeable form in soils. This fixation probably takes place, in part, by incorporation in $CaCO_3$ crystals when soils contain this material. In all soils studied, fixation appears to be caused by entry of the Sr^{90} into such solid phases as Sr or Ca phosphates or other crystals containing Sr or Ca. (auth)

17144 THE GENETIC PROBLEM OF URANINITE IN THE SOUTH AFRICAN GOLD-BEARING CONGLOMERATES. Louis T. Nel. p.15-25 of "Report of the International Geological Congress, XXI Session, Norden, Copenhagen, 1960. Part XV. Genetic Problems of Uranium and Thorium Deposits."

Deposits of uraninite associated with gold, pyrites, and minor amounts of other metallic sulphides, heavy detrital minerals, and hydrocarbon occur in conglomerates of four Precambrian systems unconformable one to another. The conglomerate ore bodies frequently rest on planes marking intraformational breaks in sedimentation or on planes of regional unconformities. Regional metamorphism has obliterated or obscured the original nature and relationships of some of the constituents of the conglomerates. There are, in the matrix of the conglomerates, intricate intergrowths of the ore minerals and other textural, attack, and replacement features like those seen in ore deposits of hydrothermal origin. The distribution of the ores is unrelated to faults and other cross-cutting structures but is intimately related to sedimentary features. In this paper some of the evidence available is presented which indicates that both

the uranium and gold were incorporated into the conglomerates either during the deposition of the conglomerates or soon after they were laid down. (auth)

17145 GENESIS OF URANIUM BELTS OF THE COLORADO PLATEAU. E. A. Noble. p.26-39 of "Report of the International Geological Congress, XXI Session, Norden, Copenhagen, 1960. Part XV. Genetic Problems of Uranium and Thorium Deposits." (RME-132)

Most major uranium deposits of the Colorado Plateau are localized within restricted, elongate mineral belts. As no special features within the host rocks obviously account for the localization of ores, it is postulated that ore deposition was caused by some change within the mineralizing solutions. It is further postulated that ore deposition resulted from decreasing pressure in laterally-moving, uranium-bearing ground water. The uranium is believed to have been derived from breakdown of uraniferous volcanic debris within the sedimentary rocks. Pressure resulting from compaction of the sediments and lateral compression would cause the ground water to move through aquifers. Decrease in pressure, away from the source, would decrease the solubility of the uranium and permit its precipitation. A mineral belt is thus delimited at one margin by a paleo-isobaric surface, marking the pressure at which precipitation could begin, and at the other margin by a roughly parallel surface marking the limit beyond which depleted solutions no longer formed major deposits. (auth)

17146 ROLE OF TRACE AMOUNTS OF URANIUM IN SOME BASE METAL SULFIDES FROM VEIN DEPOSITS. Harold D. Wright, Chester M. Smith, and Josef J. Hutta. p.248-60 of "Report of the International Geological Congress, XXI Session, Norden, Copenhagen, 1960." Part XVI. Genetic Problems of Ores.

The amount and distribution of uranium were studied in 270 samples of pyrite, sphalerite, and galena associated with uraninite in vein deposits of the western United States. The role of the uranium in the sulfides was investigated in detail in an effort to evaluate its relationship to the uranium content of the ore-forming solution. A test of Poisson distribution of alpha tracks in autoradiographs provided a means of establishing homogeneity of uranium distribution, indicative of incorporation during crystallization. Although the uranium content ranged from one to several thousand parts per million, homogeneously distributed uranium is limited to samples with less than 80 ppm. Similar upper limits in all three minerals, together with experimental evidence cited, suggest that the homogeneously distributed uranium entered the minerals by adsorption during crystallization, rather than incorporation in the lattice. Interpretation of trace elements in minerals has been seriously handicapped by a lack of means for establishing their role, whether included in foreign matter during crystallization, incorporated in the lattice or adsorbed during crystal growth, or introduced subsequently by replacement or by introduction along open spaces. The use of radioisotopes may be a powerful aid in experimental studies of trace elements and, in certain cases, in studies of natural minerals by radioactivation. (auth)

17147 MEASUREMENT OF MOISTURE AND DENSITY IN SOILS BY THE NUCLEAR METHOD. John L. Kuranz (Nuclear Chicago Corp., Des Plaines, Ill.). p.40-54 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

A nuclear method for measuring moisture and wet density in soils is described. The wet density in pounds per cubic foot is obtained using the principle of gamma backscattering. The moisture content in pounds per cubic foot or per cent volume is obtained with moisture gages using the principle of fast neutron moderation. Both instruments are shown in detail. (N.W.R.)

HEALTH AND SAFETY

17148 (APAE-79) HAZARDS SUMMARY REPORT FOR THE SM-1 CORE TEMPERATURE AND FLOW INSTRUMENTATION (TASK XIV). J. R. Coombe, ed. (Alco Products, Inc., Schenectady, N. Y.). Mar. 30, 1961. Contract AT(30-3)-326. 66p.

The changes in SM-1 incurred by the experiment, Core Temperature and Flow Instrumentation (Task XIV), are described, and the possible hazards involved in these changes are evaluated. The hazards evaluation consists of a nuclear evaluation, thermal and hydraulic analysis, a description of tests to be performed, and a discussion of containment integrity and maximum accident considerations. (auth)

17149 (CF-61-4-45) ON THE ACTIVITIES IN THE PLANT OFF-GAS. S. Fujii, J. F. Manneschmidt, T. S. Mackey, and E. W. Woodall (Oak Ridge National Lab., Tenn.). Apr. 19, 1961. 18p.

Measurements were made of the activities in the Laboratory off-gas, and efficiencies of the gas cleaning facility were calculated. Sampling was done isokinetically and particulates and adsorbable gases were collected on filter paper and charcoal traps. A special refrigerated system was employed for trapping rare gases. I^{131} and Ru^{106} were the predominant activities found in the system and at times their concentration levels caused the 3039 stack discharge to exceed the maximum permissible concentration. Efficiencies of the gas cleaning system ranged from less than 50% for gaseous material to 99.9% for particulates. (auth)

17150 (HW-29615(Rev.)(Del.)) HAZARDS OF EXPOSURE TO TRITIUM AND TRITIUM OXIDE. Roy C. Thompson and H. A. Kornberg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1, 1954. Decl. with deletions Mar. 3, 1960. Contract W-31-109-Eng-52. 41p.

Experimental data pertinent to the evaluation of hazards involved in the exposure of personnel to tritium and tritium oxide are reviewed. Conclusions are drawn and recommendations made with regard to the control of these hazards. (auth)

17151 (MND-M3A-2496(Vol.I)) PM-3A NUCLEAR POWER PLANT HAZARDS SUMMARY REPORT—PLANT DESIGN. W. Haass (Martin Co. Nuclear Div., Baltimore). Mar. 1961. 257p.

Precautions taken in the design of the PM-3A nuclear power plant (1.5 Mwe) in Antarctica are discussed. The primary and secondary systems, control, instrumentation, and shielding are treated. (D.L.C.)

17152 (MND-SR-2259) 5-WATT RADIOSTRONTIUM GENERATOR FOR AN UNATTENDED METEOROLOGICAL STATION. HAZARDS SUMMARY REPORT. C. O. Riggs (Martin Co. Nuclear Div., Baltimore). Feb. 1960. 53p.

It is noted that the chief potential radiological hazards posed by radiostrontium are direct external radiation exposures, and internal radiation exposures as a consequence of ingestion and inhalation. The conclusions to be derived from the analysis are that containment for the strontium titanate is maintained under all credible accidents and that the relative insolubility of the fuel minimizes internal exposure even if it is released to the biosphere under incredible circumstances. (J.R.D.)

17153 (MND-SR-2308) 100-WATT RADIOSTRONTIUM GENERATOR FOR LAND- AND SEA-BASED APPLICATIONS. HAZARDS SUMMARY REPORT. C. O. Riggs (Martin Co. Nuclear Div., Baltimore). Mar. 1960. 34p.

The radiostrontium generator produces 100 electrical watts from radioactive beta decay energy which is converted thermoelectrically. The fuel is 320 kilocuries of strontium-90 with a half-life of 28 years for the land-based concept and 280 kilocuries for the sea based version. The fuel form is strontium metatitanate ($SrTiO_3$), a relatively insoluble, chemically stable compound. The fuel pellets are enclosed in a fuel container placed in a multivessel containment. The land-based concept uses 120 pairs of lead telluride thermoelectric elements and the sea-based one uses 132. These are placed against a heat accumulator and operate at hot junction temperatures of 529 and 512°C in air, respectively. The cold junction temperatures are 140 and 123°C, respectively. At present, Strontium-90 is a nuclear waste material derived from spent reactor fuel that is processed at Oak Ridge National Laboratory. Strontium titanate is made by stoichiometrically compounding strontium with titania, sintering and pelletizing at 5 tsi pressure. Solubility studies of strontium titanate have indicated relative insolubility. Biological shielding against the direct radiation of the heat source is provided by a Hastelloy C shield which also serves as an outer containment vessel. The fuel emits beta, x and gamma radiation. The prototype generator will supply power for an unattended marine power source and various land applications. The precautions against radiation exposure inherent in the generator are multiple containment, biological shielding, and an insoluble fuel. The generator is designed within the framework of all credible accidents. (auth)

17154 (NP-10093) REPORT OF THE COMMITTEE ON THE SAFETY OF NUCLEAR-POWERED MERCHANT SHIPS. (Gt. Brit. Ministry of Transport). 1960. 57p.

Presented to Parliament by the Minister of Transport by Command of Her Majesty, February 1960.

Safety problems arising from nuclear propulsion in merchant ships at sea and in port were investigated. The studies were based on the assumption that nuclear-powered merchant ships will be designed as merchant ships with characteristics similar to those of conventional types. The study includes: recommendations on design and construction; operational requirements, including manning, equipment, and safety procedures; safety of navigation; operations in coastal waters and ports; disposal of radioactive waste; salvage of nuclear ships; international arrangements; and responsibilities of the government. (M.C.G.)

17155 (SC-4497(RR)) ENVIRONMENTAL BETA-GAMMA RADIOACTIVITY IN AIR AT SANDIA LABORATORY THIRD QUARTER 1960. R. E. Womelsduff (Sandia Corp., Albuquerque, N. Mex.). Oct. 1960. 12p.

Data are tabulated on the gross beta-gamma radioactivity of air samples collected during the third quarter of 1960. (auth)

17156 (TID-6055) FALLOUT PATTERNS FROM OPERATION HARDTACK, PHASE II. Kosta Telegadas and Kenneth M. Nagler (Weather Bureau, Washington, D. C.). May 1960. 124p.

Fall-out patterns from Operation Hardtack, Phase II, are presented for 31 of the 37 bursts. Those not being reported are Burst Nos. 5, 16, 20, 23, 32, and 35. Dose-rate contours were drawn for the gamma dose rate one hour after burst

time, and pertinent meteorological data are given. Errors due to passing nuclear clouds are discussed. (D.L.C.)

17157 (TID-7016(Rev.I)) NUCLEAR SAFETY GUIDE, 1961. Revised by Subcommittee 8 of the American Standards Association Sectional Committee N6 and Project 8 of the American Nuclear Society Standards Committee. (Goodyear Atomic Corp., Portsmouth, Ohio). Contract AT(33-2)-1. 42p.

The guide contains recommendations for arrays of individually subcritical units that may be applied to processing plant layout, to storage, and to the arrangement of fissionable materials shipment. Particular attention was directed to ensuring the validity of the included safety factors. (J.R.D.)

17158 (WCAP-1747) OPERATING EXPERIENCE AND ACTIVITIES OF THE LRX FACILITY. 1960 Annual Report. P. W. Davison, D. F. Hanlen, J. Jedruch (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Mar. 28, 1961. 29p.

A description of hazards evaluation for each investigation during the report period at the Large Reactor Experiment Facility is presented. Also included is information on actions taken by the Safeguards Committee. (J.R.D.)

17159 A SURVEY OF BRITISH WORK ON RADIOACTIVE FALLOUT. W. G. Marley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Bull. Swiss Acad. Med. Sci., 14: 348-66(1958). (In English)

Research carried out in the United Kingdom on radioactive fall-out from nuclear test explosions from 1954 to 1957 is reviewed. A study was made of the fate of the long-lived isotopes Sr^{90} and Cs^{137} in human food chains. The study involved measurements on animal bones, grass, foodstuffs, milk, and soil, in relation to the amount of stable calcium present. (N.W.R.)

17160 MEASUREMENT OF GONAD DOSE IN RADIODIAGNOSTIC TESTS OF CHILDREN. R. Thurau and L. Distel (Universitäts-Kinderklinik, Erlangen, Ger. and Universität, Erlangen, Ger.). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed, 94: 522-7(Apr. 1961). (In German)

An account is given of gonad dose measurements on male children between 0 and 16 years carried out during routine examinations. Condensator chambers were used. The tabulated results of the measurements show that in radiography critical doses are only produced if the gonads lie in the direct beam. With radiographs of the skull the gonad dose decreases with increasing age, with radiography of the chest it is independent of age. From measurements on an anatomical phantom the dose at the ovaries of female children was deduced. The comparison with other measurements shows the importance of coning down. (auth)

17161 RADIOLOGICAL MONITORING OF THE ENVIRONMENT IN NEW YORK STATE. Sherwood Davies and William J. Kelleher. Health News (Albany, N. Y.), 37: 4-13(Oct. 1960).

Since 1953, a radiological surveillance program has been carried out by the New York State Health Department. This program has provided for the collection of samples of air, water, precipitation, and milk. Prior to 1959 gross beta analysis was used. Since February 1959 the beta bone seeker method has been employed. This method includes analysis of the alkaline earths, some of the rare earths, and radium. Levels of radioactivity have varied with the extent of weapons testing and meteorological conditions. During the period 1955 to 1960 the maximum monthly average of beta activity in fall-out in precipitation was recorded in October 1958; in air, in February 1959; in public water supplies, between January and April 1959; and in milk, in June 1959. (auth)

17162 THE DECORPORATION OF RADIONUCLIDES. A. Catsch (Institut für Strahlenbiologie am Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 3: 97-102(Mar. 1961). (In German)

A survey is given on the basic principles, possibilities, and limits for the treatment of poisoning with radioactive substances. (tr-auth)

17163 THE STATE OF PRACTICAL FILM DOSIMETRY. K. Becker (Kernforschungsanlage, Jülich, Ger.). Kerntechnik, 3: 120-6(Mar. 1961). (In German)

The selection of the measuring film and film packaging, the possibilities of packet design, the work techniques, and the problems of arrangement are briefly reviewed. (tr-auth)

17164 RADIATION PROTECTION. Shields Warren (New England Deaconess Hospital, Boston). New Eng. J. Med., 264: 705-11(Apr. 6, 1961).

The biological effects of exposure to radiation from various sources are reviewed. It is pointed out that varying needs make it desirable that different standards of protection against radiation be applied to several categories of the population. These groups are listed as patients receiving radiation therapy or exposed to diagnostic x rays, workers using or exposed to ionizing radiation, and the general population. Procedures for radiation protection at all exposure levels are reviewed. (C.H.)

17165 SPACE RADIATIONS: NATURAL AND MAN-MADE. MEMORIAL FUND LECTURE. Payne S. Harris (Los Alamos Scientific Lab., N. Mex.). Radiology, 76: 532-9(Apr. 1961).

A general review is presented of the physical and medical concepts of space radiations, their sources, and effects. It is apparent that many problems are involved covering the radiation source and effect spectrum as it is known today, and that a thorough understanding of the problems affecting man may be paramount in his scientific advance into the spatial environment. The standards of protection and the level of risk acceptable for space exploration must be established if the full potential of man is to be realized in space conquest. (auth)

17166 THE DISTRIBUTION OF RADIOISOTOPES. PUBLIC SAFETY ASPECTS. G. R. Newbery (Radiochemical Centre, Amersham, Bucks, Eng.). Roy. Soc. Health J., 80: 220-8(July-Aug. 1960).

In the United Kingdom the Radiochemical Centre is responsible for the production and distribution of all radioisotopes made in reactors. Radiation hazards are discussed and methods are summarized for the safe handling and transport of packages containing radioisotopes. (C.H.)

17167 RADIATION HAZARDS IN THE DISTRIBUTION AND USE OF LUMINIZING COMPOUNDS. C. O. S. Blyth Brooke. Roy. Soc. Health J., 80: 228-31(July-Aug. 1960)

Hazards of radiation from the distribution, sale, and use of radioactive luminescent materials are discussed. Measures are suggested for the control of radiation hazards during the use of these substances. (C.H.)

17168 ZINC-65 IN REACTOR WORKERS. Stanton H. Cohn, Robert A. Love, and Ernest A. Gusmano (Brookhaven National Lab., Upton, N. Y.). Science, 133: 1362-3(Apr. 28, 1961). (BNL-5177)

Zinc-65, found in cyclotron workers and in other specialized populations, is now detected in a group of reactor workers. While the highest levels detected are less than 0.2% of the maximum permissible concentration, the move-

ment of this neutron-induced radionuclide is of interest, and the baseline information is important for future studies. (auth)

17169 MEDICAL AND PUBLIC HEALTH ASPECTS OF NUCLEAR WEAPONS INCIDENTS IN PEACETIME. Theodore C. Bedwell, Jr., Alvin F. Meyer, Jr., John R. Allen, Jr., and Hugh B. Mitchell. U. S. Armed Forces Med. J., 11: 961-90(Sept. 1960).

Radiation hazards are discussed that may result from peacetime nuclear weapons incidents. Contamination from Pu and U may result. It is emphasized that prompt response and professional competence in handling such incidents are necessary in order to ensure the safety of the public. (C.H.)

17170 THE AEROBIOLOGY OF RADIOACTIVE FLOATING DUST. K. Bisa. Z. Aerosol. Forsch. u. Therap., 8: 159-68(1959).

The biological problems connected with the continual increase of radioactive aerosols in the atmosphere are discussed. The possibility of approximately estimating the resulting dangers through mathematical approximation is considered. (auth)

17171 RADIATION PROTECTION: A PROBLEM IN OCCUPATIONAL AND PUBLIC HEALTH. H. J. Dunster (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.173-83 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Safeguards for protection against the hazards of radiation are discussed from the standpoint of occupational and public health. Data are tabulated on the annual dose from natural radiation sources and the maximum permissible concentrations of 24 radioisotopes of biological interest. (C.H.)

17172 RADIOSTRONTIUM. Symposion des "Sonderausschuss Radioaktivitat" vom 28.bis 31. Oktober 1959 in Bad Kreuznach. Strahlenschutz Heft 18. (Radiostrontium. Symposium of the "Special Committee on Radioactivity" from October 28 to October 31, 1959, in Bad Kreuznach. Radiation Protection No. 18). Munich, Gersbach & Sohn Verlag, 1961. 342p.

The papers given at the symposium on radiostrontium are presented and are abstracted individually. The discussions at the close of each session are also printed. The topics discussed at the conference were physical properties of radiostrontium and radiochemical determination, dispersal and fall-out of fission products, contamination of soil and plants, contamination of foods, contamination of men and animals, metabolism and distribution, dose estimation, embryological aspects of Sr^{90} incorporation, and decorporation and resorption reduction. (J.S.R.)

17173 PHYSICAL DATA ON STRONTIUM ISOTOPES (Sr^{89} AND Sr^{90}); CONTAMINATION OF AIR AND PRECIPITATION. G. Schumann. p.15-24 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The production of Sr isotopes in atomic explosions with the resulting contamination of the atmosphere and the ground by fall-out is reviewed. The atmospheric accumulation up to equilibrium is considered, and some data from 1957 are summarized. (J.S.R.)

17174 RADIOCHEMICAL DETERMINATION OF STRONTIUM ISOTOPES. E. Groos. p.25-9 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

A brief survey is given of the chemical properties of Sr^{89} and Sr^{90} with respect to their determination. Separation procedures are described. The discussion is limited to "classical" methods. (J.S.R.)

17175 UTILIZATION OF ION EXCHANGERS FOR THE SEPARATION OF RADIOSTRONTIUM. J. Schubert. p.30-3 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The principles of chemical separation with ion exchangers are reported. This method is often applied to the separation of individual radioisotopes from fission product mixtures and to the determination of Sr^{90} in fall-out. The structure and reactions of ion exchangers are described. Some methods offering good possibilities for ion exchange separation are indicated. (J.S.R.)

17176 ROUTINE METHODS FOR Sr^{90} DETERMINATION WITH ION EXCHANGERS. A. Hinzpeter. p.34-42 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

In this simple rapid method for the processing of large amounts of water, Sr^{90} is identified and measured through its daughter Y^{90}. The enrichment of Y^{90} to amounts directly measurable with G-M tubes or scintillation counters is done in two steps. The first step is the adsorption of the total activity in an ion exchange column. In the second stage Y^{90} is eluted with 5% ammonium citrate at a pH 2.8 to 3.0. The perturbations and improvements of the method are reviewed, with a discussion of the effect of high Ca or Fe concentrations on the accuracy of the determinations. The cost of the method and its accuracy are briefly considered. (J.S.R.)

17177 METHODS AND RESULTS OF THE DETERMINATION OF THE TOTAL β ACTIVITY AND Sr^{90} IN CISTERN WATER. H. Knapstein. p.43-5 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

As a preliminary to the study of Sr^{90} activity in drinking water, a study was made of the classical method for the separation of Ca, Sr, and Ba. These were not sufficiently accurate, and an ion exchange method was investigated and perfected so that all three-valent ions were eluted as a group, then Mg and Ca, followed by Sr, and lastly Ba. However, the presence of organic substances and silicates necessitates a selective precipitation. An evaporation of the silicates with concentrated sulfuric and hydrofluoric acids is sometimes necessary. (J.S.R.)

17178 STRONTIUM-90 IN THE STRATOSPHERE. J. Spar. p.51-5 of "Radiostrontium." Strahlenschutz No. 18. J. D. Spar. p.51-5 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The High Altitude Sampling Program, initiated in 1956, has the purpose of determing the atmospheric burden of particulate nuclear debris. The sampling process is described, and the stratospheric inventory of Sr^{90} was determined by integration for 10° latitude belts for each hemisphere. The results obtained for the period November 1957 through November 1958 are tabulated. It was concluded that the stratosphere does not retain nuclear debris as long as previous estimates have suggested, the residence time being 4 to 9 months for Soviet tests and 9 to 15 months for U. S. and British tests. A mechanism for stratospheric fall-out is suggested. (J.S.R.)

17179 THE LARGE-AREA DISPERSAL AND DISTRIBUTION OF RADIOACTIVE FISSION PRODUCTS IN THE ATMOSPHERE. H. W. Georgii. p.56-62 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

A survey is made on the global distribution of Sr^{90} in the soil, precipitation, and air in order to obtain from these observations an indication of the mechanism for the dispersal. It was shown that the present state of research on the atmospheric circulation in the higher layers and on the exchange mechanism between stratosphere and troposphere permits at least a qualitatively good description which explains the Sr^{90} distribution in air, precipitation, and soil. (J.S.R.)

17180 THE RESIDENCE TIME OF Sr^{90} IN THE ATMOSPHERE. W. Klug. p.63-6 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

For the prediction of the accumulated Sr^{90} on the ground, the known models on transport and exchange processes are of little help as they are for qualitative descriptions and permit no quantitative statements. The introduction of various meteorological processes in the calculation makes a mathematical solution very difficult. Therefore, the present calculations are made on a simplified model. It is estimated that there is a stratospheric reservoir of Sr^{90}, whose radioactivity decreases by decay of the isotope and by meteorological processes. The calculations were made on the basis of a 1-, 5-, and 10-year residence time of Sr^{90} in the atmosphere. The mean accumulated fall-out over the earth's surface was calculated, and the values tabulated. The fall-out for 50°N latitude was also calculated and tabulated. (J.S.R.)

17181 PERIODIC METEOROLOGICAL EFFECTS ON THE FISSION PRODUCTS AND ON THE VALUE OF THE QUOTIENT Cs^{137}/Sr^{90} IN THE ATMOSPHERE. M. Hinzpeter. p.67-77 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

In a closed aerosol system the number of particles decreases with time and the average diameter of the particles increases. The increasing mass of the particle can lead to mixing processes in the aerosol system by the fall-out of the larger particles. It is assumed that aerosols from nuclear tests are subject to coagulation. This question is investigated in two areas. First, a study is made to determine whether coagulation processes take place between the neutral aerosols in the air near the ground and the aerosols of bomb origin. Then the self-coagulation of fission products in the stratosphere, where particles with origin other than nuclear bomb research can be neglected, is treated. Mixing processes in the stratosphere are then considered. (J.S.R.)

17182 CONTAMINATION OF THE SOIL AND PLANTS. O. Siegel. p.78-86 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

As an introduction to a consideration of the Sr^{90} contamination of the soil and plants, the three ways in which the ground reacts with fall-out are discussed. These three ways are purely passive as a filter, as an ion exchanger, and as a precipitating agent. The results of two studies on Sr^{90} contamination, one made in 1956 and the other in 1959 in the German Republic, are reported. The Sr^{90} content of the arable land increased 40% in these years. The Sr uptake by plants is then reported, and the significance with respect to food contamination is discussed. (J.S.R.)

17183 CALCIUM CONTENT OF THE GROUND—EFFECT ON THE STRONTIUM UPTAKE BY PLANTS. H. Keppel. p.87-92 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The sorptive properties of the earth are first discussed in general terms. The exchange properties of Sr on clay minerals were studied using tracer techniques. For low Sr concentrations the equilibrium distribution coefficient is almost constant, but with increasing degrees of saturation it decreases. With increase of the total ion concentration and increasing cohesiveness of the other ions present, a decrease of Sr exchange occurs. The results on the study of the effect of Ca on Sr uptake indicate that the Sr and exchangeable Ca ions, with respect to a given relative availability for the plants, maintain equilibrium. In spite of various Sr and Ca contents of the individual types of plants, the Sr/Ca ratio is approximately constant and depends more on the degree of Ca saturation of the ground than on the type of plant. The effect of stable Sr on the uptake of carrier-free Sr^{90} by plants was then studied. (J.S.R.)

17184 THE QUESTION OF STRONTIUM UPTAKE BY PLANTS FROM SOIL AND AIR. A. Kloke. p.93-9 of "Radiostrontium." Munich, Gersbach & Sohn Verlag, 1961.

The effect of the calcium concentration in soil on the Sr uptake by plants was studied, and the modification of the Ca/Sr ratio by the addition of lime to the soil was reviewed. It was concluded that the uptake of Sr from precipitation and the air was essentially higher than that from the soil. (J.S.R.)

17185 INVESTIGATION OF SOIL, PASTURE GRASS, AND MILK FOR Sr^{90} (AUTUMN 1958 AND SPRING 1959). E. Groos. p.100-4 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

In order to obtain a survey on the dependence of the Sr^{90} contamination in the German Republic on the geographical position of the sampling place and the amount of precipitation, samples of soil, pasture grass, and milk were obtained at 39 places in Aug.-Sept. 1958 and Mar.-Apr. 1959, and their Sr^{90} content was determined. The results showed a dependence on the amount of local precipitation. A relationship beyond this could not be established in the area of the German Republic. (J.S.R.)

17186 UPTAKE OF Sr^{90} BY ABOVEGROUND AND UNDERGROUND PLANT PARTS: BIOLOGICAL EFFECT OF SMALL STRONTIUM MASSES. H. Glubrecht. p.105-11 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

Arabidopsis thaliana L. in pots were exposed for several generations to a finely divided spray with graduated concentrations of Sr^{90}. The uptake and distribution of the radioisotope in the plants were measured. The results led to the conclusion that the uptake depends essentially on the aboveground part of the plant. Retardation of the germination and flower formation, as well as some morphological changes, were observed as effects. The effects depend on the Sr^{90} concentration of the artificial precipitation and on the generation. The dose responsible for the effects appears to go down to the order of magnitude of 1 rad. Culture of these plants in the open after the conclusion of the experiment shows that the effects exhibit, for the most part, hereditary characteristics. (tr-auth)

17187 STRONTIUM-90 UPTAKE BY UNDERGROUND PLANT PARTS. E. L. Sattler. p.112-15 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

Since 1957 potato and soil samples have been taken from ten different soil types in Hesse. The Sr^{90} contamination of the underground plant constituents was determined, the motion of the activity was followed during the year, and the effect of the various soils was determined. The results obtained showed that the separation factor (observed ratio) generally increases with the Ca concentration. The dependence of the observed ratio on the ratios Ra/Ca or Sr/Ca in

the soil is given. The results only illustrate the tendency that a preferred Sr uptake is connected with increasing Ca content. (J.S.R.)

17188 THE UPTAKE OF FALL-OUT BY LEAVES. F. Ludwieg. p.116-21 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

A series of tests designed to determine the leaf absorption of fall-out is reported. The artificial and natural radioactivity of the plants were determined, and some of the results are tabulated and discussed. The importance of leaf absorption of fall-out is illustrated with some examples. (J.S.R.)

17189 FINDINGS AND REMARKS ON THE INTRODUCTION OF RADIOSTRONTIUM IN SOIL, VEGETATION, AND BIOCYCLES. W. Herbst. p.122-8 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The behavior of radiostrontium in soil is summarized, and its uptake by plants is discussed with respect to the Sr^{90} influx and efflux in roots and shoots. The Sr^{90} fraction passed to man in plant food is estimated. (J.S.R.)

17190 THE PASSAGE OF Sr^{90} THROUGH FOOD CHAINS. R. S. Russell. p.140-59 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

An over-all appraisal of the rate at which fission products may enter into food chains under natural conditions is presented under two sets of circumstances, continuous deposition as in world-wide fall-out and a sudden deposition of short duration as would occur from a reactor accident or close to ground zero after an atomic weapon explosion. The mechanism of direct contamination of plants is discussed. (J.S.R.)

17191 THE VALUE OF INDIVIDUAL FOODS FOR Sr^{90} INTRODUCTION. G. Kistner. p.160-6 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

Most of the radioactive fission products found in the human body are introduced by contaminated food. The relative contamination of various foods is determined. The results show that fast-growing plants with the larger surface areas contain the most activity. (J.S.R.)

17192 THE DETERMINATION OF THE MEAN CONTAMINATION OF FOODS WITH Sr^{90}. D. Merten. p.167-8 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The Sr^{90} content of the human body is determined by the amount brought into the body with food. In order to estimate the Sr level, the mean contamination must be known. This can be measured by the direct determination of $\Sigma Sr^{90}/\Sigma Ca$ in all the foods. The contamination can also be calculated from the degree of contamination of individual foods. The agreement between the direct and indirect methods is very good. (J.S.R.)

17193 EXTENDED FOOD RESEARCH WITH Sr^{90}-CONTAMINATED FOOD. K. Lang, M. Fingerhut, and W. Griem. p.184-98 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

An extended food research was made with rats to determine the effect of heightened Sr^{90} contamination on the organism. The value for the Sr^{90} content of milk averaged at 3.6 pc Sr^{90}/g Ca for the years 1955 to 1957 was used as the basic value for the contamination. The animals received a basic nourishment of skim milk powder, coarse ground wheat, and dry yeast. The food of the first research group was mixed with 72 pc Sr^{90}/g Ca and that of the second group with 180 pc Sr^{90}/g Ca. First and second generation animals were sacrificed at intervals, and a measurement was made of the weight increase, protein efficiency, number of erythrocytes and leucocytes, differential blood picture, organ weights, and the weight and number of new born and of those reaching maturity. No great variation between the two groups was established. The histological study of the liver showed in both groups a fatty deposition in the protoplasm of the Kupffer stellate cells, which increased with the length of the research time. The fatty deposition was stronger in the second group than in the first. (J.S.R.)

17194 THE QUESTION OF DISCRIMINATION IN ANIMAL OBJECTS. E. L. Sattler. p.199-200 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The element ratios Ra/Ca, Sr/Ca, or Cs/K are shifted from that in foods to that found in animal bodies over several steps in the metabolism. This shift is numerically calculated by the observed ratio. The factors affecting this observed ratio are briefly reviewed. (J.S.R.)

17195 THE QUESTION OF THE DISTRIBUTION OF Sr^{90} IN ANIMAL BODIES. W. Stahlhofen. p.201-5 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The Sr^{90} content in various organs and tissues of reindeer was determined. The activity in the soft tissues was 3 to 5 times higher than that in the bones. It is shown that the various bones have approximately the same Sr^{90} or Ra^{226} contents. Sr^{90} determinations in tissues of stags and roosters confirm the measurements on the reindeer. The activity in human organs is about 10 times higher than that in bones. The distribution of Sr^{90} in the bones was then reviewed. (J.S.R.)

17196 CALCIUM METABOLISM IN MAN. K. Lang. p.210-17 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

In connection with the problem of the deposition of a given radioisotope in the skeleton, questions on Ca metabolism are of great practical importance. In the present review, some of these problems are briefly described, especially the regulation of Ca metabolism, the Ca needs of man, and the possibility of damage from an increased Ca supply. The role of the intestines in Ca metabolism is considered, and the Ca reserve in the skeleton is discussed. The function of the kidneys in the metabolism is reviewed. Results on Ca requirements and effects of increased Ca introduction are discussed and tabulated. (J.S.R.)

17197 MINERAL METABOLISM OF THE BONES. E. Schütte. p.218-23 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

A brief review is given of mineral metabolic processes, with a discussion of both the mineral absorption and desorption. (J.S.R.)

17198 THE EFFECT OF VITAMINS ON BONE METABOLISM. G. Wilhelm. p.224-6 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

Bone is a complex system consisting of specific bone cells of organic material and mineral intercalations. This system is, however, regarded as a biological unit, but it is subjected to the control on the entire organism. In the present study a report is made on the local effects of vitamins on the bones. Vitamins C, A, and D are studied. (J.S.R.)

17199 NATURAL RADIUM CONTENT OF MEN AND ANIMALS AS A FUNCTION OF AGE. H. J. Hantke. p.227-

33 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The Ra content of chickens raised under controlled conditions of food intake was determined. The Ra content of the food was 13×10^{-15} g Ra/g food. The results show that the Ra content first decreases sharply with age and then reaches a constant value. The Ra and Ca retention as a function of age was determined up to molting. These results show that the observed ratio is age dependent. The measurement of Ra in human bones shows no age dependent increase. (J.S.R.)

17200 THE PROBLEMATICS OF SAMPLING OF BIOLOGICAL MATERIALS FOR THE INVESTIGATION OF Sr^{90} CONTAMINATION. O. Pribilla. p.234-6 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The sampling of biological materials for the study of Sr^{90} contamination involves the obtention of representative samples. It has been shown that the Sr^{90} contamination varies from bone to bone. Soft tissue sampling involves similar problems. A survey of these problems and possible partial solutions is given. (J.S.R.)

17201 COMPARISON OF THE RADIATION DOSE BY Sr^{90} IN BONES WITH THE NATURAL RADIATION EFFECT. H. Muth. p.240-52 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

A concise survey is given on the radiation burden of men from the Sr^{90} concentrations, which have been established for the human body. These values were compared with the dose by natural radiation effects and with the maximum permissible limits for Sr^{90} concentration in the human body established by the International Commission for Radiation Protection. 34 references. (J.S.R.)

17202 THE CALCULATION OF THE MAXIMUM PERMISSIBLE MASS AND THE MAXIMUM PERMISSIBLE CONCENTRATION. H. Mergler. p.253-8 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The principles and the direction and limit of calculations of the MPM and MPC are considered in order to obtain a complete mathematical derivation and the formulation of the calculus. The study is chiefly limited to Sr^{90}. It is shown how the model representations, and with them the calculation principles, changed. The obtention of new models by comparison of theory and experiments is described, and the derivation of the presently recommended values from interaction between theory and empiricism is shown. (J.S.R.)

17203 THE PROBLEMATICS OF THE ESTABLISHMENT OF THE MPC OF Sr^{90} WITH RESPECT TO THE TOTAL POPULATION. J. Schubert. p.262-7 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The utilization of probability calculations for the establishment of MPC of Sr^{90} was discussed and illustrated. (J.S.R.)

17204 UNCERTAINTIES IN THE PRESENT MPM VALUES FOR Sr^{90}. K. Aurand. p.268-72 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The formula used by the International Commission for Radiation Protection is given. The changes made between 1953 and 1959 in the Commission recommendations on MPM, effective energy per decay, relative biological effectiveness, safety factor for nonhomogeneous distribution, and fraction of the total mass deposited in critical organs are tabulated for Ra^{226} and Sr^{90}. The safety factors in each of these values are discussed, and the causes of uncertainty are reviewed. (J.S.R.)

17205 EMBRYOLOGICAL ASPECTS OF Sr^{90} INCORPORATION. H. Kriegel. p.285-9 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

Quantitative ratios in the placental transfer of radiostrontium are determined as a function of the incorporation time and the dose delivered. Rats were intravenously injected with 0.01 or 0.1 μc Sr^{90}/g on the 21st day before conception and the 1st, 5th, 10th, 15th, or 17th day of gestation. In the last days of gestation, the embryos were removed and ashed, and the activity was determined. The results are graphed and show that the later during the gestation period that the Sr uptake occurs, the greater the excessive mass in the embryo shortly before birth. (J.S.R.)

17206 RADIUM CONTENT OF HUMAN FETUS. V. Belloch-Zimmermann and E. Lohr. p.290-6 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

The radium content of 60 human fetuses was determined. Fetuses up to the fifth month were ashed in toto, but in older fetuses separate ashings of bone and soft tissues were made. The results show that a placental transfer of Ra occurs with certainty from the fourth month of pregnancy. The specific undried weight activity of both soft tissues and bones is in the order of magnitude of 10^{-15} c/g. The specific ash activity of the skeleton has the order of magnitude of 10^{-14} c/g, whereas the specific ash activity of the soft tissues varies from 4 to 96×10^{-14} c/g. It appears that in the last months of pregnancy there is no age dependence with respect to the specific activity of Ra^{226}. The specific undried weight activity of soft tissues in the last three months of pregnancy is higher by a factor of 3 than that of bones. (J.S.R.)

17207 RADIONUCLIDE INCORPORATION AND EMBRYONIC DEVELOPMENT. E. H. Graul, K. Damminger, and G. Petry. p.297-305 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

For the clarification of the effects of fall-out on the development of embryonic malformation, experiments were carried out with amphibian, chicken, and rat embryos. No malformations occurred in permanent burden with incorporated radioisotopes during embryonic development. Large doses were fatal; small doses were growth retarding. This result is not incompatible with the results of experimental teratology since there is no variation in the extent of damage of the various cell groups. The development of malformations is found, however, in disproportionate growth, that is, by irradiation during the development stage of a given organ system. Burdening the radiosensitive organ rudiments was possible in the individual development phases only by isotopes with short half lives. (tr-auth)

17208 FURTHER RESEARCH ON A DECORPORATION THERAPY AFTER INCORPORATION OF FISSION PRODUCTS. E. H. Oraul and H. Hundeshagen. p.314-23 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

Animal experimental investigations on both the possibility of a mobilization (decalcification) therapy and the combination of this therapy with chelate formation are reported. Guinea pigs received intraperitoneal injections of Sr^{90} (as the chloride), and the activity elimination quota was determined. After adjustment of a given equilibrium (constant of the elimination level), the decorporation therapy with calcium ethylenediaminetetraacetate and parathormone

alone and in combination was started. It was shown that in the combination therapy the elimination of Sr^{90} is sharply increased in comparison with the normal. These results were confirmed by quantitative determinations on rabbits and on individual skeleton parts. The application of the artificial kidney was discussed using some model studies. (J.S.R.)

17209 INVESTIGATIONS ON Sr^{90} DECORPORATION. H. Kriegel (Heiligenberg-Institut, Heiligenberg, Ger.). p.324-7 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

It is shown that the intraperitoneal injection of sodium 1,2-dihydroxy-3,5-disulfonate in the presence of other chelating agents affects Sr deposition in the skeleton and in parenchymatose organs. Some results on Sr^{90} decorporation after administration of diamond blue are given and show that the decorporation effectiveness is dependent on the dose of the dye administered. (J.S.R.)

17210 DECONTAMINATION OF SURFACE WATERS. E. H. Graul and E. H. Reinhardt. p.328-36 of "Radiostrontium." Strahlenschutz No. 18. Munich, Gersbach & Sohn Verlag, 1961.

A continuous 4-stage decontamination method is described. The process consists of prefiltration, clarification and biological filtration, sterilization filtration, and decontamination filtration. Each of these stages is described. This method can be simplified to a 2-stage process consisting of biological and decontamination filtration. The development of mobile prototypes for this method is described. (J.S.R.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

17211 (NYO-2593) UTILIZATION OF RADIOACTIVE ISOTOPES IN COAL PROCESS RESEARCH. 1st Quarterly Technical Status Report [for] March 1, 1959—May 31, 1959. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). June 15, 1959. Contract AT(30-1)-2350. 33p.

Equipment was installed and procedures developed for Project I. Methods Development for Tritium Labeling of Coal Product Hydrocarbons and Project II. Applications of Radio-Tracer Techniques to Study of Fluidized Particle Mechanics. (D.L.C.)

17212 (NYO-9141) UTILIZATION OF RADIOACTIVE ISOTOPES IN COAL PROCESS RESEARCH. 7th Quarterly Technical Status Report for November 1, 1960—January 31, 1961. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). Feb. 15, 1961. Contract AT(30-1)-2350. 20p.

Tritum-tagged naphthalene which was believed to be radiochemically pure was found to have almost $^2/_3$ of its activity in a nonhomogeneously distributed impurity in the sample. Exchange loss of tritium from carefully repurified naphthalene and purified tetralin to other hydrocarbons was measured as ~16 and 12%, respectively, at 380°C for one hour. The use of boron trifluoride catalysis for exchange tagging of hydrocarbons with tritium is being evaluated as a possible replacement of the self-labeling method. (D.L.C.)

17213 USES OF THE STABLE ISOTOPES OF BORON. S. P. Potapov. Atomnaya Energ., 10: 244-52(Mar. 1961). (In Russian)

A review is given on the properties and applications of stable boron isotopes. The transformation of a reactor neutron flux into heavy ionizing particles through the reaction $B^{10}(n,\alpha)Li^7$ makes B^{10} useful in medicine and in radiation chemistry. The difference in the B^{10} and B^{11} neutron cross sections is useful in reactor control rods and reactor shielding. (tr-auth)

17214 GAMMA LEVEL INDICATORS IN THE CHEMICAL INDUSTRY. [PART] II. H. Dijkstra and M. H. Lardinoye. Atoomenergie, 3: 33-8(Mar. 1961). (In Dutch)

After a review of safety and calculation of gamma devices in the first part of the article, the second part gives a description of the various gamma detectors used in the chemical industry. Personnel monitoring is also briefly considered. (J.S.R.)

17215 THE IRRADIATION OF FOOD. STATUS AND POSSIBILITIES. Jean-René Puig (Centre d'Etudes Nucléaires, Saclay, France). Inds. atomiques, 5: No. 1-2, 51-55; 57-61; 63-4(1961). (In French)

A survey is given of the techniques and the practical realizations in food irradiation. The principles, methods, and conditions are described. The physical, chemical, and economic conditions of success are emphasized. (tr-auth)

17216 CHERENKOV RADIATION AND ITS APPLICATION. L. S. Sklavenitis (Griechische Atomenergiekomission, Athens). Kerntechnik, 3: 114-16(Mar. 1961). (In German)

In the last few years the Cherenkov effect has attained great significance because of its technical applications. Cherenkov radiation is described and explained qualitatively. The various possibilities for the application of the Cherenkov effect are considered. (tr-auth)

17217 CONTACTLESS MEASUREMENTS OF LENGTHS AND THICKNESS WITH α, β, γ OR X RAYS. F. de Pellegars. Rev. gén. electronique, No. 171, 45-6(Feb. 1961). (In French)

The respective fields are defined in which α, β, γ and x radiations can be used. The accuracy of the methods and the half lives of the radioisotopes used are shown to be acceptable by industrial standards. Several commercially available radiation thickness gages are described in connection with their uses, mainly in metallurgy and shipbuilding. (EURATOM)

17218 FOOD PRESERVATION. F. J. Ley and P. B. Cornwell (Wantage Research Lab., Berks, Eng.). p.380-7 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Applications of ionizing radiations in the processing of food for the elimination of microorganisms, eradication of parasites, control of insect pests, and the inhibition of sprouting in stored root crops are discussed. Results are reviewed from a number of studies on the economic and practical aspects of the use of radiation facilities for food processing. (C.H.)

17219 SYMPOSIUM ON APPLIED RADIATION AND RADIOISOTOPE TEST METHODS. Third Pacific Area National Meeting, American Society for Testing Materials, San Francisco, Calif., October 13, 1959. ASTM Special Technical Publication No. 268. Philadelphia, American Society for Testing Materials, 1960. 116p. $3.75.

Eleven papers on applied radiation and radioisotope test methods are included; separate abstracts have been prepared for ten. (N.W.R.)

17220 RADIOISOTOPE METHODS OF TESTING UNIFORMITY OF COATED FABRICS. George B. Foster and Henry R. Chope (Industrial Nucleonics Corp., Columbus, Ohio). p.104-12 of "Symposium on Applied Radiation and Radioisotope Test Methods. ASTM Special Technical Publication No. 268." Philadelphia, American Society for Testing Materials, 1960.

The advantages of beta-emitting radioisotope measurement and control of coating weight and thickness is discussed by showing the quality of results from beta gages already in use. Means for automatic computation and readout of statistical production data are also shown. (N.W.R.)

ISOTOPE SEPARATION

17221 ISOTOPE CONCENTRATION SYSTEM. Jerome Saul Spevack. British Patent 865,705. Apr. 19, 1961.

An economical system for producing substances with a concentrated isotope is described. This system brings about the concentration by exchanging the isotope with another isotope of the same element between physically separable fluids (e.g., a liquid and a gas). The exchange is brought about by establishing a countercurrent flow of the two fluids in a series of exchange unit pairs, one unit of each pair being maintained at one temperature and the other at another temperature. Provision is made for heat exchange between the two units of the pairs and for stripping the two fluids from each other. Patent 865,706 is a division of this patent. (D.L.C.)

17222 ISOTOPE CONCENTRATION SYSTEM. Jerome Saul Spevack. British Patent 865,706. Apr. 19, 1961.

An economical system for producing substances with a concentrated isotope by exchange of the isotope between two physically separable fluids is described. The system consists of pairs of exchange units kept at different temperatures to bring about the exchange. The fluids preferably are H_2O liquid and H_2S gas, and stripping is effected by passing steam into H_2O to strip H_2S. Provision is made for heat exchange between the two fluids. This patent is a division of Patent 865,705. (D.L.C.)

17223 PROCESS FOR THE SEPARATION OF LITHIUM ISOTOPES. Kurt Peters. British Patent 866,720. Apr. 26, 1961.

Lithium isotopes may be separated by altering one or more parameters of a liquid system containing a compound or compounds of lithium up to but not beyond the point when crystal nuclei are first formed. The parameters are then unchanged until separation of the induced precipitate or crystallization is complete. The fraction obtained is enriched in one of the isotopes. The liquid system is maintained homogeneous with respect to the parameters during the process. The reactant used for precipitating complex compounds of lithium with Al, V, Nb, Ta, Cr, Mo, W, or U with either oxalic acid, tartaric acid or citric acid is a dilute carbonate solution. Conversion to a complex compound is formed at about 70°C. (N.W.R.)

MATHEMATICS AND COMPUTERS

17224 (BAW-TM-315) SOLUTIONS OF THE BOLTZMANN EQUATION IN TWO SPACE DIMENSIONS. E. L. Secrest (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). June 12, 1959. 35p.

A two-dimensional computer code, based on Gaussian Quadrature Theory, for calculating neutron distributions in two space dimensions is described. An outline of the program is also included. (M.C.G.)

17225 (CF-61-4-56) FPV-1, AN IBM-7090 CODE. M. E. Tsagaris and J. G. Delene (Oak Ridge National Lab., Tenn.). Apr. 18, 1961. Contract W-7405-Eng-26. 17p.

The FPV-1 code written to calculate the neutron flux level at a surface due to a finite cylindrical diffusing neutron source is presented. This IBM-7090 code was programmed to be run under control of the monitor system. (auth)

17226 (HW-66541) PROGRAM LULU. K. R. Birney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 18, 1960. Contract AT(45-1)-1350. 9p.

A IBM-709 computer program was devised for calculating the counting rates of both activities of a lutetium foil at the end of an irradiation and the spectral index (effective neutron temperature) from the activities. (D.L.C.)

17227 (HW-68527) LOLA—A MULTI-DIMENSIONAL OPTIMIZATION CODE FOR THE IBM 709-7090. M. R. Egan and C. N. Knudsen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 64p.

The LOLA computer code was developed to provide a technique for optimization of highly multivariate systems. The code employs the following statistical techniques: factorial experiment design, Yates analysis (linear fitting), and modified Box-Wilson analysis (quadratic fitting). Linkage routines permit application to a wide variety of physical or mathematical experiments. (auth)

17228 (JINR-D-573) MEASUREMENT YIELDING MAXIMUM INFORMATION AND CONTINUOUS PLANNING OF EXPERIMENTS. S. N. Sokolov (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 18p.

It is shown that the rate of accumulation of information for a given group of parameters during the measurement of some function is equal to the partial variance of that function, provided the method of least squares is valid. On this basis the problem of the continuous planning of indirect experiments is solved. (auth)

17229 (KAPL-2086) FLEER. A TWO-DIMENSIONAL TRIANGULAR MESH DIFFUSION PROGRAM FOR THE IBM 704. J. L. Fletcher, J. P. Jewett, and E. D. Reilly, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 6, 1960. Contract W-31-109-Eng-52. 65p.

FLEER is an IBM-704 program which solves the three-group, two-dimensional neutron diffusion equation in a triangular coordinate system. Up to 14,000 mesh points are allowed. The outer boundary of the point mesh must be a parallelogram. A special 120 deg periodic boundary condition is allowed on two of the sides. (auth)

17230 (LA-2520) ON THE DETERMINATION OF SAMPLE SIZE. Aaron Goldman (Los Alamos Scientific Lab., N. Mex.). Feb. 1961. Contract W-7405-ENG-36. 72p.

The problem of obtaining a sample size necessary to obtain an estimate of a parameter with a guaranteed precision was solved. A two-step technique allows for finding a sample size such that the probability is $1-\alpha$ (the confidence coefficient) that the confidence interval contains the parameter, and the probability that the width is less than or equal to d specified units is greater than or equal to β^2 (the width coefficient). The method is applied in finding necessary sample sizes for precise interval estimates of the ratio of variances from two normal populations and the parameter of the rectangular density. Expected sample sizes for the mean and variance of a normal distribution are computed. (auth)

17231 (MND-C-2205) ANPP CODE DEVELOPMENT PROGRAM PRESSURIZED WATER TASK. Quarterly Progress Report No. 6, November 1, 1960 to January 31, 1961. (Martin Co. Nuclear Div., Baltimore). Feb. 1961. Contract AT(30-1)-2431. 105p.

Final checkout, corrections, and modifications to SYNFAR, CELCOR and CSDP were completed. Improvements in tape storage completed the nuclear cross section requirements. The majority of coding on five SYBURN subroutines was completed. All corrections for input data for SYNFAR were calculated. Comparison was made between P1 and SN results for various core sizes and geometries with materials of interest in ANPP. Critical experiments were performed on Cores 402 and 404. (auth)

17232 (TID-11143) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. MATHEMATICAL METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Apr. 1960. 40p.

Work done on logical design, circuits, core storage unit, input-output, and auxiliary storage is summarized. Tolerance analysis was carried out on the AND-OR complex, non-restoring AND, and non-restoring OR. A GF45011 flowflop was designed and tested to determine the maximum possible speed of the flowgating system. Derivation of the Esaki integral in tunnel diode theory is discussed. An abstract of a report on singular shock intersection in plane flow is included. A truncation operator is defined in floating point arithmetic (error analysis). Difficulties encountered in Monte Carlo studies of order-disorder phenomena are discussed. Some of the problems treated on the ILLIAC and IBM 650 are described, and the errors encountered in these computers are analyzed. (D.L.C.)

17233 (WAPD-TM-229) TRAC-1. A MONTE CARLO PHILCO-2000 PROGRAM FOR THE CALCULATION OF NEUTRON CAPTURE PROBABILITIES. H. J. Berwind and J. Spanier (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. Contract AT-11-1-GEN-14. 38p.

A program is described which calculates a regionwise distribution of neutron capture probabilities in a two-dimensional quarter-cell by a Monte Carlo method. The program also calculates the transport theory scalar flux at a single point of the quarter-cell. As many as 75 different regions, grouped into as many as 99 different compositions, may be treated. The program operates in a one-

energy mode, or, on an input option, places a slowing-down region ahead of the one-energy thermal group. (auth)

17234 (WAPD-TM-233) THE BKS SYSTEM FOR THE PHILCO-2000 COMPUTER. R. B. Smith and C. H. Hunter (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1961. Contract AT-11-1-GEN-14. 61p.

A computer program is described which performs automatically certain logical and manual tasks required in normal start-up procedures to load and begin execution of independent digital programs on the Philco-2000 computer. This computer program provides continuous computer operation and the basic foundation necessary for efficient programming of independent digital programs. (auth)

17235 (WAPD-TM-269) REFERENCE MANUAL FOR THE BETTIS OPEN SHOP SYSTEM (BOSS-2) AS USED WITH THE PHILCO-2000. D. E. George (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1961. Contract At-11-1-GEN-14. 54p.

The Bettis Open Shop System (BOSS-2) was designed to compile and run programs written in BOSS language, a three-address, symbolic mnemonic language. It operates within the framework of the BKS System for the Philco-2000. The system, language, assembly, run, dump, and operating instructions are described. (M.C.G.)

17236 (AEC-tr-4285) NUMERICAL METHODS OF MATHEMATICAL ANALYSIS. Sh. E. Mikeladze. Translated from a publication of the State Publishing House of Technical-Theoretical Literature, Moscow, 1953. 597p. Issued in two books.

Topics in numerical analysis which still fit in the framework of classical mathematical analysis are discussed. Modified interpolation formulas, discussions of numerical integration and differentiation of functions, and information necessary for application of numerical methods to the integration of differential equations of mathematical physics are presented. Topics covered include finite differences, finite sums, divided differences, inverse differences, uniform approximations, point interpolation, quadratic approximations, Fourier series and orthogonal polynomials, empirical formulas, estension of mathematical tables, inverse interpolation, numerical differentiation, numerical integration, Euler's summation formula, summation formulas with differences, multiple summation, interpolation of functions of many variables, cubature formulas, and symbolic calculations. (M.C.G.)

17237 A CLASS OF BOUNDARY VALUE PROBLEMS. W. E. Williams (Univ. of Liverpool). Appl. Sci. Research, B, 9: 21-34(1961). (In English)

A simple method is presented for the solution of the partial differential equation of diffusion type with constant values of the solution or its normal derivative prescribed on the surfaces of a wedge of arbitrary angle. It is shown that this solution may be transformed in such a manner that it yields the solution to a similar class of boundary value problems for the time-harmonic wave (i.e. Helmholtz's) equation. Direct solutions are also obtained for the problem of the diffraction of acoustic or electromagnetic plane waves by a perfectly absorbing or a perfectly reflecting wedge. In one solution the diffraction problem is solved by modifying the solution of a similar boundary value problem for the diffusion equation. In the second formulation the solution of the diffraction problem is obtained by expressing the total solution as a sum of a diffracted field and geometrical optics terms. The diffracted field is then obtained by imposing the conditions of continuity across the shadow lines of geometrical optics. The solution for the diffraction of an arbitrary plane pulse by a wedge is also obtained; the solution being valid even if the boundary conditions are of the impedance type. (auth)

17238 IMPROVEMENTS IN OR RELATING TO MAGNETIC CORE STORAGE ELEMENTS. Ernest Franklin (to United Kingdom Atomic Energy Authority). British Patent 868,549. May 17, 1961.

A magnetic memory storage element comprising a main core and an auxiliary core is described. Each core has an input winding and an output winding. The materials of the cores, their relative cross-sectional areas, and the turn ratios of the windings in the loops are so related that a saturation-to-saturation change of main core flux density requires only a fraction of the auxiliary core flux density. The relative lengths of the windings and their turn ratios in the loop are so related that the coercive current required by the main core in its loop winding is only a fraction of the coercive current required by the auxiliary core in its loop winding. (N.W.R.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

17239 (AERE-BIB-129) URANIUM CARBIDES: A BIBLIOGRAPHY OF REFERENCES UP TO THE END OF 1959. P. J. Jones, comp. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 25p.

An annotated bibliography is presented consisting of 89 references to patents, publications, and reports concerned with uranium carbides. (B.O.G.)

17240 (BMI-1104(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE 1956. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). July 2, 1956. Decl. with deletions Feb. 18, 1960. Contract W-7405-eng-92. 88p.

Development studies are described for: reactor materials; aluminum-clad fuel elements; plant assistance to MCW; processing of feed materials; alloy and ceramic fuel elements; uranium and zirconium corrosion mechanisms; Zr-U alloys; physical metallurgy; Zircaloy-water reactions; air-flow in PWR pressure vessel; modified fuel-element cores; liquid-metal neutron absorbers for control of gas-cooled power reactors; and evaluations of reflector-controlled heterogeneous boiling reactors. (B.O.G.)

17241 (BMI-1430) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MARCH 1960. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio.). Apr. 1, 1960. Decl. May 13, 1960. Contract W-7405-eng-92. 100p.

Progress is reported for investigations of: reactor materials and components; development of fuel elements; fission-gas release from refractory fuels; gas-pressure bonding in fuel elements; development of UC; radioisotope and radiation applications; heat transfer and void distributions; materials development and evaluation; reflective insulations; recovery of spent fuel elements; variable-moderator reactor critical assemblies; Pebble-Bed Reactor materials; tantalum and tantalum alloys for LAMPRE applications; materials development for HTGR and MGCR; development of SM-2; gas-cooled reactor program; and corrosion of thorium and uranium under storage conditions. (B.O.G.)

17242 (BMI-1473) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER 1960. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Nov. 1, 1960. Decl. Jan 19, 1961. Contract W-7405-eng-92. 72p.

17243 (BMI-1480) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING NOVEMBER 1960. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Dec. 1, 1960. Decl. Jan. 19, 1961. Contract W-7405-eng-92. 72p.

17244 (DMIC-Memo-96) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. J. A. Houck (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 7, 1961. 5p. (PB-161246)

Discussions are presented of the metallurgical properties and fabrication processes for molybdenum and its alloys of titanium, tungsten, and zirconium. (B.O.G.)

17245 (KAPL-M-JDL-3) DERIVATION OF RELATIONSHIP BETWEEN THREE-POINT BENDING DEFLECTION AND MID-SPAN SURFACE STRAIN FOR A MATERIAL WITH NO STRAIN HARDENING. J. D. Lubahn (Knolls Atomic Power Lab., Schenectady, N. Y.). June 17, 1960. Contract W-31-109-Eng-52. 8p.

The relation is shown as: $\delta = \frac{l^2(Y/E)}{3t[3-(Y/E\lambda_{sc})^2]^2} \times \left\{10 - \frac{Y}{E\lambda_{sc}}\left[9 - \left(\frac{Y}{E\lambda_{sc}}\right)^2\right]\right\}$, where, δ is deflection, l is span, Y is yield strength, E is modulus, t is beam depth, and λ_{sc} is mid-span surface strain. The relation is useful in converting load-deflection data to ductility in a bend test. (auth)

17246 (NP-10046) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Mar. 1961. 53p.

The listing contains 118 references to selected documents and published literature on high-strength alloys, light metals, nonmetallics, refractory metals, coatings, and applications. Author, subject, and DMIC numerical indexes are provided to the individual references. (B.O.G.)

17247 (NP-10047) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Mar. 1961. 58p.

155 references.

17248 CONTRIBUTION TO THE QUESTION OF THE COBALT CONTENT IN REACTOR CONSTRUCTION STEEL. Kurt Fink, Nikolaus Riehl, and Ottmar Selig (Phoenix-Rheinrohr A. G., Dusseldorf and Technische Hochschule, Munich). Nukleonik, 3: 41-9(Mar. 1961). (In German)

The requirement for the lowest possible cobalt concentration in reactor steels was critically investigated with special experiments. In addition to the cobalt activity arising in steel, other activities are of special importance when construction constituents must be repaired swiftly, i.e., after a short decay time. The contribution of the various radioactive nuclides to the total activity was investigated experimentally and theoretically. The solution of the problem lies less in the lowering of the cobalt content in the steel rather than in precautions of keeping neutrons away from the steel constituents by the incorporation of neutron absorbers. (tr-auth)

17249 THE ELECTROLYSIS OF THORIUM OXIDE CRYSTALS. D. L. Goldwater (Franklin Inst., Swathmore, Penna.). Phys. and Chem. Solids, 18: 259-61(Feb. 1961). (In English)

An exponential rate law for the electrolytic liberation of O_2 from ThO_2 is always of the order eV/kT, where e and k take their usual meaning as universal constants, T is the temperature of the oxide crystal, and V the applied voltage. Values of O_2 evolution rate for one experimental run is given showing the exponential increase with voltage. The exponential character over a wide variety of conditions shows that the slope of the range to be between e/kT and 2e/kT. (N.W.R.)

Corrosion

17250 (APEX-586) PROPERTIES OF LITHIUM HYDRIDE II. LITHIUM HYDRIDE CORROSION STUDIES: 19-9DL ALLOY. Frank H. Welch (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 10, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 41p.

19-9DL stainless steel alloy sheet (AMS5526) specimens (unwelded and welded) were tested for short time tensile properties after 65 and 100 hours exposure to molten lithium hydride at 1325°F and 1425°F, respectively. As-fabricated controls and H_2 exposed controls (65 and 100 hours at 1325°F and 1425°F, respectively) were tested for comparison. Both LiH and H_2 exposed specimens exhibited slightly lower ultimate tensile and 0.2 percent yield strengths than the as-fabricated controls. Metallographic examination revealed negligible corrosion by the molten lithium hydride. Weight loss tests and chemical analyses confirmed the metallographic results. The slight decrease in mechanical properties was attributed basically to the extended heating period that the originally-solution heat treated alloy was exposed during the corrosion study. For comparison, preliminary test data on other 300 series stainless steels (Types 301, 304, 316, 316 ELC, 317, 318, 321, and 347) exposed to molten LiH under similar conditions are included. In general, similar behavior was encountered. (auth)

17251 (BNL-585) CORROSION STUDIES FOR A FUSED SALT-LIQUID METAL EXTRACTION PROCESS FOR THE LIQUID METAL FUEL REACTOR. H. Susskind, F. B. Hill, L. Green, S. Kalish, L. E. Kukacka, W. E. McNulty, and E. Wirsing, Jr. (Brookhaven National Lab., Upton, N. Y.). June 30, 1960. 41p.

A condensed version of this report appeared in Chem. Eng. Progr., 56: 57-63(1960).

Corrosion screening tests were carried out on potential materials of construction for use in a fused salt-liquid metal extraction process plant. The corrodents of interest were NaCl–KCl–$MgCl_2$ eutectic, LiCl–KCl eutectic, Bi–U fuel, and $BiCl_3$, either separately or in various combinations. Screening tests to determine the resistance of a wide range of commercial alloys to the corrodents were performed in static and tilting-furnace capsules. Some ceramic materials were tested in static capsules. Larger-scale tests of metallic materials were conducted in thermal convection loops and in a forced circulation loop. Some of the tests were conducted isothermally at 500°C, and others were performed under 40 to 50°C temperature differences at roughly the same temperature level. On the basis of metallographic examination of exposed test tabs and chemical analyses of corrodents, it was found that the binary and ternary eutectics by themselves produced little attack on any of the materials tested. A wide variety of materials including 1020 mild steel, 2¼ Cr–1 Mo alloy steel, types 304 (ELC), 310, 316, 347, 430, and 446 stainless steel, 16-1 Croloy, Inconel, Hastelloy C, Inor-8, Mo, and Ta is, therefore, available for further study. Corrosion by the ternary salt-fuel system was characteristic of that produced by the fuel alone. Alloys such as 1020 mild steel, and 1¼ Cr–½ Mo, and 2¼ Cr–1 Mo alloy steel, which are resistant to fuel, would be likely choices at present for container materials. $BiCl_3$ produced extensive attack on ternary salt-fuel containers when the fuel contained insufficient concentrations of oxidizable solutes. Au and Al_2O_3 were the only materials not attacked by $BiCl_3$ in ternary salt alone. (auth)

17252 (HW-59778(Rev.)) SUMMARY REPORT ON THE CORROSION OF ALUMINUM IN HIGH TEMPERATURE DYNAMIC WATER SYSTEMS. R. J. Lobsinger (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1, 1961. Contract AT(45-1)-1350. 18p.

Testing of aluminum alloys in high-temperature water was performed for a number of years by members of an AEC sponsored Aluminum Task Group. This report presents a narrative review of the pertinent data obtained from limited distribution Task Group reports. The effects of pH, temperature, inhibitors, heat transfer, velocity, radiation, and aluminum corrosion product concentration are covered. (auth)

17253 (HW-67370) MECHANISMS AND KINETICS OF URANIUM CORROSION AND URANIUM CORE FUEL ELEMENT RUPTURES IN WATER AND STEAM. V. H. Troutner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 21, 1960. Contract AT (45-1)-1350. 94p.

The mechanisms and kinetics of uranium corrosion and fuel element ruptures were investigated in water and steam at 170 to 500°C and at 100 to 2800 psig. The fuel element samples were coextruded Zircaloy-clad uranium-core rods and tubes which were defected prior to exposure. Uranium corrosion was found to be the sum of two processes; direct oxidation by water, and oxidation of uranium hydride intermediate. Fuel element ruptures occur in two stages; an initial induction period followed by an accelerating corrosion of the core causing the cladding to blister, swell, and fracture. Uranium corrosion and fuel element ruptures were examined with respect to temperature, pressure, steam versus liquid water, heat treatment, carbon content of uranium, zirconium content of uranium, cladding thickness, fuel geometry, annular spacings, defect geometry and size, coolant flow, hydriding of Zircaloy components, and irradiation effects. (auth)

17254 (HW-68426) CORROSION EVALUATION OF NICKEL-BASE ALLOYS DEVELOPED TO CONTAIN POWER REACTOR FUEL DISSOLVENTS. R. F. Maness (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 26p.

An alloy possessing good physical properties was developed which affords greater corrosion resistance to a wide variety of dissolvents (nitric acid, sulfuric acid, neutral and acid fluoride solutions) for power reactor fuels than any known commercially-available ferrous or nickel-base alloy. The alloy is based upon 50 wt.% Ni–25 wt.% Cr with 6 wt.% Mo, 1 wt.% Cu, 0.02 maximum wt.% C, 1 wt.% Ti, and the balance Fe. Alloys based upon 45 wt.% Ni–22 wt.% Cr with 0.02 maximum wt.% C, 1 wt.% Ti, and at least 6 wt.% Mo were only slightly less resistant. (auth)

17255 (NMI-7006) CORROSION OF ALUMINUM ALLOYS CONTAINING DISPERSED PHASES. REPORT TO E. I. DU PONT DE NEMOURS AND COMPANY. A. L. Geary (Nuclear Metals, Inc., Concord, Mass.). Oct. 28, 1960. Decl. Nov. 30, 1960. Contract AT(30-1)-1565, Sponsor Agreement No. S-7. 22p.

The corrosion behavior of consolidated mixtures of atomized aluminum powder containing fine particles of low hydrogen overvoltage materials was investigated in static autoclave tests at 200 and 250°C. It was anticipated that the particles would prevent blistering attack by acting as preferred sites for hydrogen discharge, and improve resistance to uniform attack by promoting the formation of an adherent oxide layer free of defects. The following materials were tried as low overvoltage particles: the binary compounds, Al_3Fe, Al_3Ni and $AlNi_3$; the ternary compound $Al_9(Fe, Ni)_2$ with iron to nickel ratios of 1 : 1 and 1 : 5, and elemental nickel. None of these materials improved corrosion resistance. (auth)

17256 (TID-12575) THE EFFECT OF OXYGEN PRESSURE ON THE OXIDATION OF CHROMIUM. Technical

Progress Report, March 1, 1960–February 28, 1961. Richard E. Grace (Purdue Univ., Lafayette, Ind. School of Metallurgical Engineering). Mar. 1, 1961. Contract AT(11-1)-776. 10p.

Equipment was constructed to measure the rate of oxidation of chromium in damp hydrogen. The apparatus consists of a gas train for purifying hydrogen, a large refrigeration unit used to establish dew points as low as –60°C, and a combustion chamber with a torsion fiber microbalance. A survey of recent literature on chromium oxidation is included. (M.C.G.)

17257 (TID-12602) THE ROLE OF A DISPLACEMENT REACTION IN THE KINETICS OF OXIDATION OF ALLOYS. Roger L. Levin and J. Bruce Wagner, Jr. (Yale Univ., New Haven. Hammond Metallurgical Lab.). [Apr. 25, 1961]. 38p.

The oxidation of some copper-zinc alloys and a copper-nickel alloy in pure oxygen at 700°C was studied to determine the occurrence of a displacement reaction of the type: $B^{+2} + 2e^- + AO = A^{+2} + 2e^- + BO$. The formation of BO in the displacement reaction was found to occur by observing a change in the oxide scale by metallographic examination and by noting a change in the rate of oxidation as given by the parabolic reaction rate constant. A change in the oxidation rate for several samples was further emphasized by observing the rates during two periods of oxidation which were separated by an isothermal annealing period in an inert gas. (auth)

17258 (AEC-tr-4595) CHEMICAL STABILITY OF BERYLLIUM BORIDES IN OXYGEN, NITROGEN AND CARBON AT HIGH TEMPERATURES. G. S. Markevich and L. Ya. Markovskii (Markovskiy). Translated by J. Woroncow from Zhur. Priklad. Khim., 33: 1008-12(May 1960). 8p. (XDC-61-4-18).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 18965.

17259 RESISTANCE OF STEELS AND ALLOYS OF ZIRCONIUM TO CORROSION IN SOLUTIONS OF BORIC ACID AT VARIOUS TEMPERATURES. M. A. Tolstaya, S. V. Bogatyreva, and G. N. Gradusov. Atomnaya Energ., 10: 222-56(Mar. 1961). (In Russian)

The corrosion of 1X18H9T zirconium steel with 2.5 and 1.0% Nb and carbon steel 20 by boric acid was studied. The materials were autoclave tested in 0.23 and 1.13 g/l boric acid concentrations for 1000 and 2000 hr at 335°C and 140 atm and in 5.65 g/l boric acid for 150 hr at 310°C and 100 atm. The influence of boric acid on steel corrosion (carbon steel 20, alloyed steel-X5M2, stainless steel X13, and austenite steel 1X18H9T) at 40°C in free oxygen is also reported. (R.V.J.)

17260 CORROSION OF ALUMINUM ALLOYS IN HIGH PURITY WATER IN THE RANGE 150 C–340 C. D. F. MacLennan. Corrosion, 17: 239-42t(May 1961).

Examination of the cross section of the film on aluminum and its alloys, while attached to the metal, reveals that the second phase particles play an important part in the corrosion pattern. The 2S aluminum contains at least two types of second phase particles, one of which corrodes more rapidly while the other corrodes more slowly than the surrounding aluminum. The majority of second phase particles in the 157 alloy corrode more slowly than the surrounding aluminum. (auth)

17261 THE RELATIONSHIP BETWEEN THE AMOUNT OF H_2O_2 FORMED AND THE NUMBER OF OXIDE MOLECULES DURING THE ATMOSPHERIC CORROSION OF Mg AND Al. I. L. Roikh and I. P. Bolotich (Odessa Technological Inst.). Doklady Akad. Nauk S.S.S.R., 137: 126-9(Mar. 1, 1961). (In Russian)

The growth of oxide layers on Mg and Al was followed at 20°C at a relative humidity of 63% by following the elliptical polarization of light reflected from the surface of the sample. Rectification of the experimental curves showed that for the first five hours, $L^2 = 31$ t for Al and $L^{2.69} = 63$ t for Mg, where L is the thickness of the oxide film in Angstroms and t is the time in hours. The amount of hydrogen peroxide formed was also followed by observing the blackening caused by samples placed on film and subjected to the same conditions of temperature and humidity. A direct relationship exists between the amount of H_2O_2 formed and the thickness of the oxide layer, as determined by these two methods. It was found that one molecule of H_2O_2 corresponds to the formation of 11.5 molecules of Al_2O_3, while 27.5 molecules of MgO are formed per molecule of H_2O_2. (TTT)

17262 OPTICAL PROPERTIES OF ANODIC OXIDE FILMS ON TANTALUM, NIOBIUM, AND TANTALUM + NIOBIUM ALLOYS, AND THE OPTICAL CONSTANTS OF TANTALUM. L. Masing, J. E. Orme, and L. Young (Univ. of British Columbia, Vancouver). J. Electrochem. Soc., 108: 428-38(May 1961).

The reflectivity of anodized electropolished tantalum was measured as a function of angle of incidence for 4358A light polarized in the plane of incidence. The principal aim of these measurements was to obtain the refractive index of the oxide. This is needed to determine absolute thicknesses of oxide by the spectrophotometric method in which the wavelengths of minimum reflectivity due to interference at near normal incidence are determined. The measurements also provided a method of determining the optical constants of the metal, without assuming that the surface is perfectly flat or that an unanodized surface is free from oxide. It was found that films formed on tantalum in 0.2N H_2SO_4 have a thin outer layer of light-absorbing oxide. The bulk of the film is, however, nonabsorbing and homogeneous. A large part of the thickness of films formed in concentrated sulfuric acid absorbs light. The refractive index at 4358A wavelength of films formed in dilute solution increases by about 0.3% per tenfold decrease in the current density at which they are made and by about 0.06% per 10°C rise in the temperature at which they are made. The refractive indices of films formed on niobium, on 25 at.% Ta–75 at.% Nb, and on 25 at.% Nb–75 at.% Ta were estimated and a preliminary study was made of films on zirconium. (auth)

17263 MOTION PICTURE STUDIES OF COLUMBIUM OXIDATION. W. T. Hicks (E. I. du Pont de Nemours & Co., Wilmington, Del.). Trans. Met. Soc. AIME, 221: 218-20(Apr. 1961).

Visual observation of the oxidation of Nb shows that the protective behavior noted previously in gravimetric work in the early stages of the reaction below 600°C and throughout the reaction at 640°C is associated with an adherent oxide. The fact that the oxide is seen to move outward from the metal at temperatures from 550° to 935°C implies that the reaction takes place at the oxide-metal interface throughout this temperature range. (auth)

17264 OXIDATION OF NIOBIUM (COLUMBIUM) IN THE TEMPERATURE RANGE 500° TO 1200°C. Per Kofstad and Hallstein Kjöllesdal (Central Inst. for Industrial Research, Blindern-Oslo, Norway). Trans. Met. Soc. AIME, 221: 248-9(Apr. 1961).

The oxidation behavior of niobium was studied in the

temperature range 500° to 1200°C and at oxygen pressures of 760, 100, 10, 1, and 0.1 mm of Hg. The work comprises kinetic studies of the oxidation as well as structural investigations of the oxidized specimens by means of x-ray diffraction, electron diffraction, electron microscopy, and metallographic techniques. The oxidation reaction has a highly irregular temperature dependence and is unusually sensitive to changes in the oxygen pressure. The complex oxidation behavior is suggested to be due to formation of different Nb_2O_5 modifications in different temperature regions. During oxidation oxygen is also dissolved in the metal. Formation of oxide whiskers take place on the oxide surface at temperatures above approximately 800°C. (auth)

17265 KINETICS OF THE OXIDATION OF CHROMIUM CARBIDES. T. Ya. Kosolapova and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukranian SSR). Zhur. Fiz. Khim., 35: 363-6(Feb. 1961) (In Russian)

The kinetics of oxidation of powder and massive specimens of chromium carbides were investigated. It is found that the initial oxidation temperature for all three specimens of powdered carbides is 700°. Massive specimens of Cr_3C_2 and $Cr_{23}C_6$ are stable at 800 to 1000°; Cr_7C_3 oxidizes at 800°. Oxidation of powdered Cr_3C_2 at 800 to 1000° obeys the parabolic law, Cr_7C_3 the logarithmic, and $Cr_{23}C_6$ the parabolic at 800° and the logarithmic at 900° and 1000°. (tr-auth)

17266 CATALYTIC EFFECTS DURING THE AIR-OXIDATION OF GRAPHITE. H. Hering, S. Keraudy, F. M. Lang, and S. May (Commissariat a l'Energie Atomique, Paris). p.115-22 of "Proceedings of the Fourth Conference on Carbon." New York, Pergamon Press, 1960. (CEA-1815) (In French)

There is a remarkable coincidence between the positions of autoradiographic spots corresponding to preferential localization of sodium, and the holes formed during the air-oxidation of industrial graphites. A rigorous analysis carried out in two cases showed that a number of impurities occurred in greater concentrations at these spots than outside them; by this means the occurrence of the localization of impurities already observed by other methods was confirmed. Localized corrosion was obtained artificially by the introduction in powder form of chemical substances similar to the impurities found. An attempt was made to evaluate the chemical activity of these impurities and their mutual promotion effects, by introducing them into high purity graphites; this was done by impregnating the graphite with the solutions and evaporating in vacuum. (auth)

Fabrication

17267 (60-RL-2432M) THE DEPOSITION OF PYROLYTIC GRAPHITE. R. J. Diefendorf (General Electric Co. Research Lab., Schenectady, N. Y.). Apr. 22, 1960. 11p.

Work is presented which shows the deposition of pyrolytic graphite to be controlled by reactions in the gas phase. Experiments were performed at fast and slow rate of growth using natural, pyrolytic, and commercial graphites as substrates. The deposition processes occurring at various temperatures and pressures for all three substrates are described. (D.L.C.)

17268 (AD-243850) DESENSITIZATION OF ZIRCONIUM POWDER USED IN PRIMERS (PHASE I). Peter Karlowicz, George Norwitz, and Joseph Cohen (Frankford Arsenal, Philadelphia). June 1960. 22p. (T60-24-1).

The factors influencing the sensitivity of zirconium powder and previous methods of desensitization are discussed. A practical and inexpensive method for desensitization is proposed by treatment with 1% hydrofluoric acid for 5 minutes. The electrostatic energy required to set off the powder increased considerably after the treatment and the usefulness of the zirconium for primers was not impaired. The effect of the desensitization on visual appearance, appearance under the microscope, particle size, and behavior on burning was investigated. The solubility losses for the desensitization process using the hydrofluoric acid treatment are about 1%. Treatment with non-oxidizing acids will produce varying degrees of disensitization but the use of hydrofluoric acid is preferable. (auth)

17269 (AD-245350) MANUFACTURING DEVELOPMENT OF TUNGSTEN ALLOYS FOR ROCKET NOZZLES. Mid-Year Report on (Phase II). Report No. 2-CPFF-WG-78256-1-I-(4). A. E. La Marche (Westinghouse Electric Corp. Materials Mfg. Dept., Blairsville, Penna.). Sept. 1, 1960. 31p.

A report is presented on the data accumulated on vacuum-arc skull casting of W–Mo alloys and pure W. Melting of a 70 wt.% W–30 wt.% Mo alloy electrode stub resulted in a melted end with small round holes formed by volatilized impurities, and a specification was drafted for the chemical composition of starting W powders. AUC and ATJ grades of graphite were found to be more suitable than the CS grade for fabricating the casting molds. Graphite molds at room temperature appear to be better than preheated molds. The temperature of the W arc was calculated to be ~10,000 to 11,000°F, and the power delivered to the anode is 8 to 25 times as large as that received by the cathode or consumable electrode. The effect of 1% or more Mo in W appears to lower the surface tension of the bath. Reclamation of pure W scrap was done in both arc casting and skull casting processes, but 50 wt.% W–50 wt.% Mo alloy scrap could not be recovered. Attempts to produce a pure W skull casting were unsuccessful due to the inability to tilt pour the skull crucible after melting. The grain size of all the vacuum-arc skull cast W was smaller than that of a vacuum arc melted ingot, and the skull casting as tilt poured from the crucible toward the graphite mold was more ductile than that in the vacuum-arc melting process. The problems and advantages associated with the skull casting process are discussed. (D.L.C.)

17270 (AERE-M-443) CUTTING IRRADIATED BERYLLIUM. M. H. Delve (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1959. Changed from OFFICIAL USE ONLY Mar. 27, 1961. 7p.

Equipment and techniques used for sectioning specimens of irradiated beryllium of about 6 curies activity are described. An underwater cutting machine designed for sectioning irradiated fuel elements was used. This method was found to be satisfactory and safe. (M.C.G.)

17271 (CEA-1750) SINTERING WITH A CHEMICAL REACTION AS APPLIED TO URANIUM MONOCARBIDE. A. Accary and R. Caillat (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 21p.

A survey is given of investigations of the preparation and fabrication of uranium monocarbide for nuclear use. If a chemical reaction takes place in the sample during the sintering operation, if may be expected that the atom rearrangements involved in the reaction should favor the sintering process and thereby lower the temperature needed to yield a body of a given density. Using this hypothesis, the

following methods were studied: sintering of U–C and UO_2–C mixtures; hot pressing; and extrusion of U–C mixtures. To generalize the result, it could be said that a chemical reaction does not lead to high densification, if one depends on a simple contact between discrete particles. On the contrary, a chemical reaction can help sintering if, as the hot pressing experiments show, the densification can be achieved prior to the reaction. (auth)

17272 (CEI-118(Rev.)) PREPARATION OF UO_2 PELLETS CONTAINING FLUORIDE. W. T. Bourns (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 28, 1960. Reprinted Feb. 1961. 7p. (AECL-1201)

An irradiation experiment is being conducted to test whether the presence of fluoride in UO_2 causes catastrophic failure of UO_2 fuel elements sheather in Zircaloy-2. The experiments performed to determine a method of retaining fluoride in high concentrations (approximately 600 ppm F^-, U basis) in sintered UO_2 pellets are described. The addition of the fluoride as calcium fluoride and the use of a modified sintering cycle was found to give satisfactory fluoride retention. (auth)

17273 (DP-563) A REMOTELY OPERABLE CUTTER FOR IRRADIATED METALLIC-URANIUM TUBES. Frederick C. Locke, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1961. Contract AT(07-2)-1. 8p.

A hydraulically powered tube cutter was developed for remotely cutting irradiated tubes of uranium metal and uranium alloys. The cutter operates under water, and the parts subject to wear are readily accessible for replacement. (auth)

17274 (HW-44088(Del.)) WELDING CHARACTERISTICS OF ZIRCALOY JACKETED FUEL ELEMENTS. J. W. Lingafelter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1956. Decl. with deletions Feb. 2, 1960. 16p.

The final closure on 20 Al–Si-bonded and 20 unbonded-Zircaloy jacketed fuel elements was effected using inert-gas-shielded tungsten arc-welding processes. The welding was done using a manually operated production welding table modified to hold an auxiliary gas-shielding chamber. The procedures developed for effecting the final closure were amenable to normal production welding rates. (auth)

17275 (MAB-171-M) JOINING OF REFRACTORY SHEET METALS. (National Research Council. Materials Advisory Board). Mar. 20, 1961. 25p.

Considerations are given for joining sheet materials produced from alloys based on molybdenum, niobium, tantalum, and tungsten for use in applications involving temperatures in excess of 2000°F, a variety of environs, and stresses lasting for various lengths of time. The processes discussed include riveting, gas welding, electron beam welding, resistance welding, ultrasonic welding, and brazing. Recommendations derived from the considerations are outlined. (B.O.G.)

17276 (NP-10061) AEROSOL PREPARATION OF COMPOSITE METAL POWDERS FOR DISPERSION STRENGTHENING. Final Report. C. D. McKinney and W. B. Tarpley (Aeroprojects, Inc., West Chester, Penna.). Mar. 1961. Contract NOas 59-6247-c. 56p. (RR-61-30)

The feasibility of utilizing aerosolization apparatus for preparing composite metal powders of value in the preparation of high-temperature dispersion-strengthened metals was demonstrated in the nickel–alumina, nickel–chromic oxide and tantalum–alumina systems. The aerosolization apparatus produces, from bulk powders, individually dispersed particulate clouds which at the instant of separation are individually coated with the composite-forming shell material. Refractory coatings were dispersed on micron-sized preformed metal particles in order to provide materials analogous to the starting powders of the SAP process. Preformed submicron refractory particles acting as deposition nuclei were also coated with metal shells by gas-phase chemical reaction of a volatile metal compound. After extrusion, chromic oxide particles dispersed in nickel had a mean free path of 0.5 microns. Tantalum with dispersed submicron alumina showed a mean free path of 1 micron. Judging by electron microscopic criteria, these metals should have superior high-temperature properties in fabricated shapes to the limit of stability of the dispersed phase and possibly to 0.9 of the homologous temperature. (auth)

17277 (NP-10119) FEASIBILITY STUDY OF PLASMA WELDING OF REFRACTORY METALS. Final Report. Oliver Preston (Stanford Research Inst., Menlo Park, Calif.). Feb. 20, 1961. For Bureau of Naval Weapons. Contract NOas-59-6234-c. 33p.

A study was made of the feasibility of fusion welding of the refractory metals with the plasma torch. A torch with interchangeable nozzles of $\frac{1}{16}$-, $\frac{1}{8}$-, and $\frac{1}{4}$-inch diameter was developed for this purpose. Welding with the conventional plasma torch was not possible, owing to severe blowing of the weld pool by the high-velocity gas jet. With a new type of plasma torch, designed to operate at very low gas flow rates, disturbance of the weld pool was eliminated, and fusion welds were produced in steel, Mo, Ta, W, and Ta–10% alloy. However, the high heat-transfer rate, characteristic of the conventional plasma torch, was not obtained with the low-velocity jet. It was concluded that the inert-gas tungsten-arc and the electron beam are the most satisfactory methods for fusion welding of the refractory metals. Recommendations are made for modification of the inert-gas tungsten-arc torch, to take advantage of some of the features of the plasma jet. (auth)

17278 (ORNL-3077) FABRICATION DEVELOPMENT OF UO_2-STAINLESS STEEL COMPOSITE FUEL PLATES FOR CORE B OF THE ENRICO FERMI FAST BREEDER REACTOR. J. H. Cherubini, R. J. Beaver, and C. F. Leitten, Jr. (Oak Ridge National Lab., Tenn.). Apr. 18, 1961. Contract W-7405-eng-26. 96p.

The development of an inexpensive composite fuel plate with a high burnup potential for application in a 500°C sodium environment as Core B of the Enrico Fermi Fast Breeder Reactor is described. The dispersion fuel product consists of 35 wt.% spheroidal UO_2 dispersed in type 347B stainless steel powder and clad with wrought type 347 stainless steel. Nominal over-all dimensions of Type II design fuel plates are 18.97 in. long × 2.406 in. wide × 0.112 in. thick with 0.005-in. cladding. Reliable processing methods for achieving a uniform distribution of spheroidal UO_2 in the matrix powder and cladding the sintered powder compact by roll bonding are described. Examination of experimental plates reveals that the degree of UO_2 fragmentation and stringering encountered during processing is primarily a function of the degree of cold work employed in the finishing operation and the starting quality of the UO_2 powder. Cladding studies indicate that a sound metallurgical bond can be achieved with an 87.5% reduction in thickness at 1200°C and that close processing control is required to meet the stringent tolerances specified. The developed process meets all criteria except possibly the surface finish requirement; occasionally, pitting occurs due to scale embedded during hot working. Detailed procedures covering composite plate manufacture are presented. (auth)

17279 (TID-12447) SWAGING OF URANIUM DIOXIDE. Quarterly Report No. 1 for the Period May 1 to July 31, 1960. (FIAT. Sezione Energia Nucleare, Turin). Aug. 31, 1960. 52p. (Includes original, 31p.). (FN-E-1). AEC 86/Euratom 164

The swaging technique seems likely to offer an inexpensive method for the production of fuel rods for nuclear reactors. The scope of the reported research work is to study the effects of various parameters on the characteristics of swaged tubes of stainless steel or Zircaloy-2 compacted with UO_2 powder. A review of research work carried out earlier in the United States and Canada is presented, along with a brief account of the equipment and materials used for the present investigation. Techniques evolved for production of test specimens required in the study of the swaging parameters, thermal conductivity, and the gamm-ray absorption of swaged UO_2 are described. The tests in progress, and the working program to be implemented during the second quarter are outlined. Preliminary tests provided evidence that densities of 93% of theoretical can be reached. (auth)

17280 (TID-12448) SWAGING OF URANIUM DIOXIDE. Quarterly Report No. 2 for the Period August 1 to October 31, 1960. (FIAT. Sezione Energia Nucleare, Turin). Nov. 30, 1960. Contract EUR/C/434/60 I. 34p. AEC 86/Euratom 164

An investigation of fused UO_2 powder (Spencer swageable grade) undertaken previously was continued. Fabrication of core-length rods is reported. In the best specimen obtained UO_2 density reached 89.6 ± 1% of theoretical. An investigation of gamma-absorption density determination of rods is being carried out according to schedule. Preliminary measurements of the thermal conductivity of swaged UO_2 showed values much lower than those attributed to pellets of corresponding density. (auth)

17281 (TID-12449) STEAM SINTERING OF URANIUM DIOXIDE. Quarterly Report No. 1, September 1 to November 30, 1960. (FIAT. Sezione Energia Nucleare, Turin). Contract EUR/C/1658/603 i. 68p. (Includes original, 35p.). (FN-E-3) AEC 88/Euratom 93

The use of a steam atmosphere instead of the more conventional hydrogen atmosphere appears to be one of the best means of reducing the cost of sintering UO_2 for use in manufacture of fuel elements for reactors. A program of research was laid down with the object of clearing up the many confused points and with the object of evaluating the practical and economic possibilities of the process. Details are given of the work initiated in the laboratories of the FIAT, Nuclear Energy Section, which consists for the most part of the construction and putting into working order of the apparatus which will be used. (auth)

17282 (TID-12482) URANIUM OXIDE EXTRUSION. Quarterly Report No. 1. (Compagnie Industrielle des Céramiques Electroniques, Paris). Dec. 15, 1959. EURATOM Contract EUR/C/1323/3/59. EURATOM/U.S.A. Agreement Proposal No. 37. 9p.

Rotary cylindrical rods were made of natural UO_2 with a density above or equal to 92% theoretical by camphor extrusion of UO_2 with average specific surface. Up to 100 mm in length, deformation during sintering, without special precautions was acceptable and allowed later rectification of the rods. It was confirmed that the specific surface of the raw material is a deciding factor in the densification of the rods during sintering. Camphor bonds gave better results than those tried previously. (auth)

17283 (TID-12500) BONDING PLASTIC LAMINATES ONTO METAL. Lloyd C. Jackson (Bendix Corp., Kansas City, Mo.). [nd.] 6p.

Two ways of adhesive bonding plastic laminates to metal are described, and the merits and demerits of each are given. Considerations involved in the choice of the adhesive are discussed. The strengths of a plastic laminate assembly bonded to aluminum with any one of three epoxy-phenolic adhesives or a nitrile-phenolic adhesive are graphically compared with each other after being subjected to various cure cycles. (D.L.C.)

17284 (VDIT-30) AUTOMATIC WELDING METHODS, IN PARTICULAR AS APPLIED TO PIPES. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Mar. 1961. 10p.

Thirty-one references, most with abstracts, are presented on automatic welding. Welding methods for pipes are given particular attention. (D.L.C.)

17285 THE PLUTONIUM FABRICATION SHOP AND THE FUEL FOR RAPSODIE. R. Abramson, P. Bussy, A. Junca, R. Mas, Y. Masselot, A. Robillard, and F. Stosskopf (Commissariat à l'Énergie Atomique, [Paris]). Énergie nucléaire, 3: 47-62(Jan.-Feb., 1961). (In French)

The different fuels which have been proposed for fast neutron reactors are reviewed, and the composition and fabrication of the fuel elements for Rapsodie are examined in some detail. To illustrate the special techniques for the use of plutonium, the design of the plutonium shop at Cadarache is given. (tr-auth)

17286 FABRICATION STUDIES ON COLUMBIUM ALLOY SHEET. Andrew F. Trabold and Steven Bank (Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y.). Metal Progr., 79: 103-7(May 1961).

Preliminary tests indicate that D-31 sheet (10% Mo, 10% Ti) has relatively good formability; its machining characteristics are similar to austenitic stainless steel. The alloy has fair bendability, but its weldability leaves much to be desired. The material can be sheared cold; it can be dimpled at 500°F but not at room temperature.

17287 IMPROVEMENTS IN OR RELATING TO METHODS OF JOINING GRAPHITE TO GRAPHITE AND GRAPHITE TO METAL SURFACES. Hugh Wilson Davidson and John Walter Ryde (to General Electric Co., Ltd.). British Patent 865,592. Apr. 19, 1961.

A method for joining graphite to graphite and metal surfaces is described. In this method, the graphite surfaces are subjected to an atmosphere of nickel carbonyl and heated (200 to 500°C) to cause deposition of nickel thereon. The nickel-coated surfaces are subsequently bonded either to each other or to metal surfaces. One advantage of this method is that there is no increase in the gas content of the graphite material joined in this way. (D.L.C.)

17288 FABRICATION OF TUBE TYPE FUEL ELEMENT FOR NUCLEAR REACTORS. E. Loeb and J. H. Nicklas (to U. S. Atomic Energy Commission). U. S. Patent 2,983,660. Feb. 4, 1959.

A method of fabricating a nuclear reactor fuel element is given. It consists essentially of fixing two tubes in concentric relationship with respect to one another to provide an annulus therebetween, filling the annulus with a fissionable-material-containing powder, compacting the powder material within the annulus and closing the ends thereof. The powder material is further compacted by swaging the inner surface of the inner tube to increase its diameter while maintaining the original size of the outer tube. This process results in reduced fabrication costs of powdered fissionable material type fuel elements and a substantial reduction in the peak core temperatures while materially enhancing the heat removal characteristics.

Properties and Structure

17289 (AD-244009) RESEARCH ON THE COMPATIBILITY OF MATERIALS WITH CHLORINE TRIFLUORIDE PERCHLORYL FLUORIDE AND MIXTURES OF THESE. Third Quarterly Technical Summary Report, May 1, 1960 to July 31, 1960. John C. Grigger and Henry C. Miller (Pennsalt Chemicals Corp., Wyndmoor, Penna.). Aug. 15, 1960. Contract AF33(616)-6796. 24p.

An investigation was made to determine the compatibility of materials with chlorine trifluoride, perchloryl fluoride, and mixtures of these to the limit needed in modern large-scale rocketry. All 21-day immersion tests at 30°C of unstressed specimens in pure liquid chlorine trifluoride, pure liquid perchloryl fluoride, and a liquid mixture of 25% perchloryl fluoride-75% chlorine trifluoride were completed. All metals exhibited very low corrosion rates in the liquids, generally less than 0.2 mils/yr, with a maximum of 0.4 mils/yr. The fluorinated plastics Kel-F and Teflon showed a moderate weight gain on exposure to the 25% ClO_3F-75% ClF_3 liquid mixture just as they did on exposure to the individual liquids. Calcium fluoride-filled Teflon showed only a small weight gain on exposure to the liquids. Polyvinylidene fluoride plastic on exposure to liquid perchloryl fluoride exhibited a weight gain about the same as that of Teflon, and much less than Kel-F. High density carbon and graphite were found to disintegrate to powders on contact with liquid chlorine trifluoride below 25°C. Liquid immersion tests at 30°C for 21 days of stressed specimens (U-bend) of eight alloys were completed in the liquids. No evidence of stress corrosion was found. In immersion tests in wet perchloryl fluoride (0.2% H_2O), nickel, monel, aluminum, magnesium, copper, brass, aluminum bronze, and low-carbon steel all suffered a mild to moderate attack in both vapor and liquid. Pitting was observed, especially with monel in the vapor. Stainless steels, 403 and 316, and titanium (which appeared resistant to wet perchloryl fluoride at low moisture levels and in the presence of more easily attacked metals) were corroded to varying degrees when exposed alone to wet perchloryl fluoride containing 1.0% H_2O. Pitting or localized etch was observed in all cases, particularly in crevices. The liquid-vapor diagram for the ClO_3F-ClF_3 system was determined, and shows a large positive deviation from an ideal solution with respect to perchloryl fluoride. Mixtures of chlorine trifluoride and perchloryl fluoride held in metal containers show the same oxidizer-metal interaction as other strong oxidizers when subjected to a high detonation shock, which is greater for aluminum than for steel, or stainless steel. Other metals such as magnesium may also show this enhancement. Severe mechanical shock on steel shipping cylinders containing mixtures of perchloryl fluoride and chlorine trifluoride failed to initiate any noticeable action between either the gas or the liquid mixture and the steel cylinder. (auth)

17290 (AD-245892) STRUCTURAL INVESTIGATIONS IN THERMOELECTRIC MATERIALS. Progress Report No. 2, August 1–September 30, 1960. P. I. Pollak, J. B. Conn, R. C. Taylor, E. Sheehan, and C. Barklay (Merck, Sharp and Dohme Research Labs., Rahway, N. J.). Contract NObs-78503. 11p.

Work is described on the thermoelectric alloy system $Bi_{24}Sb_{60+x}Se_6Te_{150-x}$. Methods of preparation involving the Bridgman and zone refining techniques are outlined. The thermoelectric properties of alloys where x varies from −8 to +12 are presented. These data show that an optimum figure of merit may be obtained in a region where x is equal to 8. The quaternary composition with x equal to 8 was investigated. Resulting information shows that optimum properties can be obtained in zone-levelled samples. Figures of merit in excess of 4×10^{-3}/°K were calculated from the pertinent thermoelectric parameters. Compositional changes in the alloy involving the ratio of selenium to tellurium, the replacement of bismuth by antimony, and the replacement of antimony by tin and arsenic were investigated. Hall measurements were carried out on some alloy compositions and a mobility of 320 cm^2/volt-sec. was found at room temperatures for the alloy composition. Replacing antimony by arsenide afforded an n-type material. (auth)

17291 (AD-245923) REFRACTORY GADOLINIUM AND HAFNIUM COMPOUNDS. Monthly Report for the Period August 1–August 31, 1959. (Nuclear Corp. of America. Research Chemicals Div., Burbank, Calif.). Contract NObs 77145. 3p.

Electrical resistivities were measured at 26 and 180°C for the following gadolinium compounds: Gd_2Sb, Gd_3Sb_2, Gd_3Bi, Gd_4Bi_3, GdBi, $GdBi_2$, Gd_3Si, Gd_2Si, Gd_4Si_3, GdSi, and $GdSi_2$. Most of the measurements were made on arc-melted specimens. Previously reported data collected at 26°C are included. (D.L.C.)

17292 (ARF-2189-17) HIGH-TEMPERATURE CREEP EVALUATION IN CARBON DIOXIDE ATMOSPHERE. Summary Report, October 1, 1959–March 31, 1961. R. F. Domagala (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 31, 1961. For General Nuclear Engineering Corp. Subcontract No. 40-2-1. 34p.

The creep-rupture properties of type 347 stainless steel, an Fe–Al–Cr alloy designated 261C, and a zirconium-base alloy identified as AE1H were determined in a CO_2 atmosphere. Tests were conducted at 1050°, 1100°, 1300°, and 1500°F. An atmosphere of high-purity CO_2 gas was maintained around the specimens during the total life of each run. Specimens were evaluated under stress-temperature conditions defined by GNEC; the duration of testing varied from 50 to 10,000 hours. Minimum creep rate, per cent elongation, and rupture life were determined and are reported. Individual creep curves as presented for each test, and typical photomicrographs are shown for samples after exposure. Carbon analyses were run on samples taken from the stressed portions of most of the sixteen tests conducted. (auth)

17293 (ARF-2210-2) IMPROVED VANADIUM-BASE ALLOYS. Bimonthly Report No. 2. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 24, 1961. Contract NOw 61-0417-c. 16p.

Solid solution and dispersion-strengthened vanadium–niobium base alloys were fabricated to sheet by hot or cold rolling. Excellent workability of V–60 wt.% Nb base materials was demonstrated by cold rolling directly to 0.050-inch sheet. Tensile data at 2000°F show that maximum strengthening of the V–20 wt.% Nb and V–60 wt.% Nb bases were produced by 5 wt.% and 0.5 wt.% titanium, respectively. Room-temperature properties of welded vanadium–niobium base alloys were similar to those of the parent materials: welded V–5 wt.% Ti–20 wt.% Nb passed a 1.2t bend, and V–60 wt.% Nb passed a 2.5t 180 degree bend. At 2000°F, the welded specimens approached the strength of the base metals, but were less ductile. (auth)

17294 (CF-54-10-106) THERMAL STRESSES IN BERYLLIUM. TEST NO. 1. R. W. Bussard and R. E. MacPherson (Oak Ridge National Lab., Tenn.). Oct. 25, 1954. Decl. Mar. 22, 1961. 36p.

The high power density volume heat source effect induced by neutron and gamma heating in a reactor was simulated by electrical resistance heating of a beryllium block. Holes

were drilled in the block to provide flow passages for sodium used to remove the internally generated heat. Operation at 1100 to 1200°F with internal temperature difference as high as 150°F and with cyclic variation of average power density from 15 to 40 watts/cm^3 did not cause cracking or distortion in the test sample. No corrosion or mass transfer was observed anywhere in the test loop. (auth)

17295 (DMIC-151) ENVIRONMENTAL AND METALLURGICAL FACTORS OF STRESS-CORROSION CRACKING IN HIGH-STRENGTH STEELS. C. J. Slunder and W. K. Boyd (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 14, 1961. 21p. (PB-151110)

Stress-corrosion cracking is defined as the complex interplay of tensile stress and corrosion which leads to cracking. The effect is a highly localized attack without significant general surface corrosion. The cracks produced tend to grow in a plane perpendicular to the tensile stress, and in a "stop and go" fashion. Theories of stress-corrosion cracking are discussed. The philosophy of laboratory investigation of stress-corrosion cracking also is commented upon. (auth)

17296 (DMIC-Memo-95) STRENGTHENING MECHANISMS IN NICKEL-BASE HIGH-TEMPERATURE ALLOYS. C. H. Lund and D. C. Drennen (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 4, 1961. 20p. (PB-161245).

A review is given of the various mechanisms from which nickel-base superalloys derive their high-temperature strength. The strengthening mechanisms discussed include solid-solution hardening, precipitation hardening, and strengthening with additions of boron and zirconium, which are discussed in terms of dislocation theory. Considerations are given for failures, heat treatment, and related grain-boundary behavior. (B.O.G.)

17297 (DMIC-Memo-99) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF HIGH-STRENGTH STAINLESS STEELS. D. A. Roberts (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 14, 1961. 4p.

A brief summary of recent developments in high-strength stainless steels is presented. The information was made available to DMIC during Jan. to Mar. 1961 and includes data on alloy development and on properties of existing steels. (J.R.D.)

17298 (DMIC-Memo-100) REVIEW OF CURRENT DEVELOPMENTS IN THE METALLURGY OF HIGH-STRENGTH STEELS. H. J. Hucek and A. R. Elsea (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 20, 1961. 4p. (PB-161250)

Recent developments in the metallurgy of high-strength steels are summarized from literature received by DMIC in the period Jan. 1 to March 31, 1961. New data on the hardening and other mechanical properties of AISI 4340 steel are reported. Impurities were found to lower the impact properties of commercial ordnance steel. The properties of Rocoloy 270 are described. The effects of decarburization on ultrahigh-strength steel are discussed. (D.L.C.)

17299 (FD-43) SOME PROPERTIES OF ALUMINUM–URANIUM ALLOYS IN THE CAST, ROLLED AND ANNEALED CONDITIONS. T. I. Jones, I. J. McGee, L. R. Norlock (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). June 1960. 29p. (AECL-1215).

The metallographic and hardness changes associated with the rolling and subsequent annealing of aluminum alloys containing up to 30 wt.% uranium were described. The alloys possessed good rolling properties. However, the richer alloys were unusual in that after an initial reduction, further cold rolling caused softening. In the alloy range examined, increasing uranium contents caused reduced preferred orientation. Qualitative explanations were proposed to account for the observations on roll softening and preferred orientation. Heat-treating and aging experiments confirmed that the solid solubility of uranium in aluminum is negligible. (auth)

17300 (LMSD-89083) TENSILE FAILURE OF QMV BERYLLIUM FROM ROOM TEMPERATURE TO 870°C. M. I. Jacobson and F. M. Almeter (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Mar. 1961. 28p.

Short-time tensile tests of hot-pressed QMV beryllium were made at temperatures of 20 to 870°C. Mechanical properties were correlated with BeO content (0.8 to 2.0%) and with microstructure. Elongation increased with temperature to a maximum at 425°C, decreased to 760°C, and again increased at 815°C for samples with low BeO content. Samples with 2% BeO exhibited no increase in elongation at 815°C. Fracture was transcrystalline to 480°C, initiated by stress concentration at twin intersections, intersections of twins with grain boundaries, at {1012} twin-matrix interfaces, and at impurity particles, particularly carbides. Intercrystalline fractures, starting at 480°C, were characterized by void formation at grain boundaries normal to the stress axis. The amount of cavitation increased to a maximum at 760°C, and thereafter decreased as the temperature increased to 870°C. Voids were observed to have nucleated at carbide particles in grain boundaries. Presumably other impurities, such as BeO, are also capable of nucleating voids, although no direct confirmation of this could be obtained because such particles were small in comparison to the size of the voids. Striking evidence for the role of impurities in void formation was obtained in alloys of low BeO content, which contained several clusters of very large grains in a fine-grained matrix. The boundaries of these large grains were free of visible impurity particles and contained no intercrystalline voids, while the surrounding fine-grained materials contained impurity particles in the grain boundaries and numerous voids and cracks. Current fracture theories are used to explain the role of impurities and mechanical effects, e.g., grain boundary sliding and migration, as factors which contribute to intercrystalline failure of beryllium at elevated temperature. (auth)

17301 (NAA-SR-54(Del.)) THE ELECTRICAL RESISTIVITY AND ITS TEMPERATURE COEFFICIENT FOR IRRADIATED GRAPHITE. D. T. Eggen and Phyllis Stello (North American Aviation, Inc., Los Angeles). Mar. 16, 1950. Declassified with deletions May 3, 1960. 18p.

The temperature coefficient of electrical resistance was measured on various types of artificial graphite irradiated in a Hanford reactor and the Los Alamos plutonium reactor. This coefficient had a minimum value, as was predicted theoretically, at a neutron exposure of about 3 to 4×10^{17} n/cm^2 in the Los Alamos reactor. Increasing neutron exposures increased the temperature coefficient, which started to saturate at Hanford exposures of about 200 Mwd/ct. This increase due to irradiation annealed out under heat treatment to 2000°C. There was little difference in the coefficient between different types of graphites at equal exposure. Electrical resistance as a function of exposure in the Los Alamos and Hanford reactors was also measured. These data confirmed those previously reported, showing significant differences between the various graphite types. (auth)

17302 (NP-10051) THE EFFECT OF ARC PLASMA DEPOSITION ON THE STABILITY OF NON-METALLIC MATERIALS. Bi-Monthly Report No. 6, January–February 1961. B. E. Kramer and M. A. Levinstein (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 3, 1961. Contract NOas 60-6076-C. 9p. (DM 61-94)

Plasma flame spraying studies were conducted on high-melting-point oxides, carbides, and nitrides using three different types of nozzles on the plasma jet spraying equipment. Compressive strength is reported for TaC and ZrN. Room temperature x-ray studies were made on all materials and x-ray studies at temperatures at 2500°F were started. (auth)

17303 (NP-10054) PRESSURE DEPENDENCE OF THE ELASTIC SHEAR CONSTANTS OF LITHIUM. Solid State Physics Program. Technical Report No. 5. A. L. Jain (Case Inst. of Tech., Cleveland). Feb. 1961. Contract Nonr-1141(05). Project NR 017-444. 20p.

The elastic shear constants $C = C_{44}$ and $C' = \frac{1}{2}(C_{11}-C_{12})$ of lithium were measured as a function of pressure at room temperature. The measured values of the quantity, $-d\ln C/d\ln r$, are C, 4.1 and C', 2.8. This inequality of the two pressure variations is contrary to the situation found in sodium, where the two coefficients were equal. Theoretically, the two coefficients are expected to be the same, if only the electrostatic interaction between the electrons and the ions is responsible for the elastic stiffness of the metal. The different behavior in lithium can be understood in terms of the extra contribution to the shear constants arising due to the change in the Fermi energy of the electron on shearing. (auth)

17304 (NP-10067) CRACK INITIATION AND PROPAGATION IN HIGH STRENGTH ALLOY SHEETS. BIBLIOGRAPHY 3. Georges Sertour (North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development). Oct. 1960. 39p.

A bibliography is presented of knowledge on the subject which may be of use in research. (348 references). (J.R.D.)

17305 (NP-10068) PARAMETRIC STUDIES OF METAL FIBER REINFORCED CERAMIC COMPOSITE MATERIALS. Final Report, January 1960–January 1961. Tien-Shih Liu and Elbridge Z. Stowell (Southwest Research Inst., San Antonio). Jan. 26, 1961. Contract NOas 60-6077-c. 73p.

The purpose of this program was to conduct a theoretical study of the various parameters which affect the mechanical characteristics of metal fiber reinforced ceramic composite materials. In addition, a survey of properties of potential fiber and matrix materials was made so that promising combinations needing intensive investigation can be defined in specific terms. Certain room temperature mechanical behavior of metal fiber reinforced ceramics (MFRC) were predicted using an inclusion concept and from geometric, elastic, statistical distribution and plastic strength considerations. Certain elevated temperature mechanical behaviors of MFRC were predicted using a universal visco-elastic concept. A survey of pertinent physical, chemical and mechanical properties was made on refractory metals, metal oxides, carbides, borides, nitrides, silicides, sulfides and single crystal whiskers. Areas of research for the development of fiber reinforced materials in general and of MFRC in particular were recommended. (auth)

17306 (NP-10106) PHASE EQUILIBRIA AND TRANSFORMATIONS IN METALS UNDER PRESSURE. Larry Kaufman (Manufacturing Labs., Inc., Cambridge, Mass.). Apr. 1, 1961. Contracts NONR 2600 (00) and AF33(616)-6837. 97p.

An attempt was made to correlate the information obtained from high pressure studies of phase equilibria in metals with one atmosphere thermodynamic data. Both one- and two-component metallic systems were studied. It was found that in most cases, quantitative thermodynamic predictions at a level of accuracy and reliability comparable to current high pressure observations could not be carried out. In cases where the nature of the high pressure phase could be directly determined or inferred with some assurance, qualitative predictions of high pressure effects could be made by the proper use of one atmosphere thermodynamic data. (M.C.G.)

17307 (OOR-821:7) ON THE THERMALLY ACTIVATED MECHANISM OF PRISMATIC SLIP IN MAGNESIUM SINGLE CRYSTALS. Technical Report No. 7. P. Ward Flynn, J. Mote, and J. E. Dorn (California. Univ., Berkeley. Materials Research Lab.). Dec. 1, 1960. Contract DA-04-200-507-ORD-171. 23p.

The effect of strain and strain rate on the critical resolved shear stress for prismatic slip in specially oriented single magnesium crystals was determined over a range of temperatures to identify the thermally activated strain-rate controlling dislocation process. Below about 450°K prismatic slip was preceded by twinning and fracturing. Above 450°K extensive prismatic slip was obtained followed by fracturing. Neither the Peierls' mechanism nor the dislocation intersection mechanism can account for the observations. The data are in excellent agreement with the dictates of Friedel's theory for cross-slip to the prismatic plane. (auth)

17308 (OOR-2771.2) THERMAL CONDUCTIVITY OF LEAD AT LOW TEMPERATURE. Technical Report No. 1. Charles L. Wolff (Illinois. Univ., Urbana). Jan. 1961. 54p.

Low temperature thermal conductivity measurements were made in the superconducting and normal states of Pb samples with impurities <.05 at.%. The measurements were combined with earlier data on Bi–Pb alloys to display an isothermal relation between the strength of point-defect scattering and the ratio, K_s/K_n, of the thermal conductivity in the two states. As long as only electron conductivity is important, K_s/K_n varies linearly with the square root of the ratio, r, of point-defect scattering resistance to phonon scattering resistance in the normal state. The relation holds for the Hg data of Hulm. The specimens studied had values of r from .02 to 2. An extrapolation to r = 0 of the linear relation provides curves which are interpreted as the temperature dependence of K_s/K_n in perfectly pure Pb and Hg. The curves do not agree with the theory of Kadanoff and Martin unless it is assumed that the energy gap at absolute zero is $7.3\ kT_c$, which is almost twice that indicated by other experiments. As was observed before in these metals, K_s/K_n is also not explained by the theory of Bardeen, Rickayzen, and Tewordt. The thermal magnetoresistance of Pb was measured in longitudinal field and compared with earlier results. The longitudinal and transverse resistance appear to approach each other above 4°K in Pb, while below this temperature their behaviors are radically different. An attempt to identify isotope scattering of phonons in the superconducting state proved inconclusive. (auth)

17309 (ORO-380) [THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F]. Second Monthly Status Letter. James A. Long (Southern Research Inst., Birmingham, Ala.). July 6, 1960. Contract AT-(40-1)-2694. 10p.

Characteristics of induction heating of graphite balls with

thermal shielding of graphite, molybdenum, carbon steel, and austenitic stainless steel are discussed. A literature study on air bearings was continued. (M.C.G.)

17310 (ORO-381) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Third Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Aug. 12, 1960. 13p.

An investigation of gas bearings is being carried out in order to provide design information. Changes made in the design of an optical extensometer included a revision of the image analyzer which will let the servo run the light to zero instead of to a balance of half-wave pulses of light. An electromechanical drive system is being superimposed on an existing hydraulic tensile machine to provide a wide range of strain rates in the tensile facility. The machine is being modified to accept the mechanical equipment. (M.C.G.)

17311 (ORO-382) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Fourth Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Sept. 14, 1960. 6p.

Fabrication of items required for evaluation of gas bearings is in progress. A mechanical layout study was made of an optical extensometer system to explore the usefulness of commercially available slide assemblies. It was decided that a ball-and-groove slide assembly could be designed and constructed especially for this application. Modifications to the basic loading system frame were completed and the frame was reassembled. (M.C.G.)

17312 (ORO-383) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Fifth Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Oct. 14, 1960. 17p.

The resistance-heated check-out furnace was operated at 5500°F and is ready for use. Preliminary designs of the induction-heated furnace resulted in satisfactory operation to 4500°F. The gas bearings were checked out under loads up to 10,000 lb and demonstrated a friction force of less than $\frac{1}{2}$ lb at 700 lb load. Grips were preliminarily checked out up to 10,000 lb load on metal specimens. Detailed designs were made of the optical strain analyzer and the components ordered. The loading system is being aligned with all components now on hand. (auth)

17313 (ORO-384) THE TUBE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Sixth Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Nov. 10, 1960. 15p.

Additional furnace work using the 25-kw induction power supply indicated reliable long-time performance at 4500°F. The detailed check out of the prototype, flat, gas bearing was completed. Bearing operation was very stable at 0.0005-in. gap. The design of the spherical bearing was begun. The grips were checked with a single graphite specimen and indicated satisfactory performance with specimen failure at the anticipated ultimate stress. The loading system was assembled, aligned, and operational check out completed. Design study of the optical strain analyzer was continued. (auth)

17314 (ORO-385) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Seventh Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Dec. 15, 1960. 8p.

The tubular furnace was employed to heat a graphite specimen to 5130°F. Operation was very satisfactory. The design of the spherical gas bearing was completed and fabrication started. The need to water-cool the grips was established, since they heated to 900°F at a specimen temperature of 4000°F. The loading system was operated repeatedly and the preliminary check out of the instrument system was completed. A model of the strain analyzer is being assembled to check the mechanical and optical performance. (auth)

17315 (ORO-386) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Eighth Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Jan. 13, 1961. 7p.

The equipment for the evaluation of the stress-strain properties of brittle materials is ready for the initial tensile tests at up to 5000°F. The tubular furnace was modified slightly to permit the grips to pass through the heater and thus provide a simpler procedure for installing specimens prior to a pull. Fabrication of the spherical gas bearings was completed. Attachments are being designed to mount both gas bearings in the loading linkage. Room temperature runs were made to establish the linearity of the mechanical loading system and to develop operating techniques. Both steel and graphite specimens were run. The non-uniaxial load when not using gas bearings was established as about 20% even after very careful prealignment. The grips were redesigned slightly to provide more gripping area on the specimen. A preliminary model of the strain analyzer was assembled and initial evaluations made to establish the optical performance of the proposed system. (auth)

17316 (ORO-387) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Ninth Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Feb. 17, 1961. 11p.

The first runs with the gas bearings operable were made on the equipment at up to 4500°F. The data indicated that the gas bearings have a significant influence in reducing any bending of the specimen. Graphite appeared to be significantly stronger and more ductile than previously reported. Even strain cracks were observed in some specimens. The tubular furnace was enlarged slightly and performance proved up to 4500°F. No difficulty was anticipated to 5200°F since the previous design was satisfactory to this temperature. The gas bearings were mounted in the load frame. The coefficient of friction acting through the bearings on the specimens was less than 5×10^{-7}. The resulting bending stress distortion in the specimen was less than 0.2 psi. Some small modifications were made in the precision grips. Almost all major work on the load frame was completed. (auth)

17317 (ORO-388) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Tenth Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Mar. 9, 1961. 9p.

Runs on the zirconia-coated graphite established that the ultimate strength of this material is 30 to 100% greater than previously reported. This greater strength was apparently obtained because the gas bearings eliminate all bending moments in the specimens and the radiant heating provides more even and measurable temperatures. The ultimate strength of one pyrolytic graphite specimen was found to be over 33,600 psi at 4000°F. The performance of the resistance-heated furnace was very satisfactory. The gas bearings were dismounted, cleaned, plated, and are being reinstalled. Some limit switches were added to the load frame to provide protection from overtravel. (auth)

17318 (ORO-389) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Eleventh

Monthly Report. C. D. Pears (Southern Research Inst., Birmingham, Ala.). Apr. 10, 1961. 7p.

The preliminary design of the induction heated furnace was operated to 5100°F. Performance was satisfactory. The gas bearings were reinstalled and preliminary runs made on a dummy and one graphite specimen. Another variation in grip design was developed to permit the evaluation of the dumb-bell type specimen using conical grips. Preliminary check out of the strain analyzer indicated that focus will be no problem over an interval of at least $\frac{1}{8}$ in. The sensitivity of the analyzer appeared to be adequate using a hot filament to simulate the flag signal. (auth)

17319 (SCDR-243-60) DESIGN CONSIDERATIONS IN THE USE OF 5000 SERIES ALUMINUM ALLOYS. C. H. Maak (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. 21p.

Information is presented concerning the general nature of the series of aluminum alloys containing magnesium as the main alloying element. The individual forms in which they are offered to users by aluminum producers are discussed, and specific alloys and tempers for each form are recommended. Aspects of stress corrosion cracking, arc welding, and forming which the design engineer should consider are indicated. (auth)

17320 (TID-11768) POINT DEFECT HARDENING IN FACE-CENTERED CUBIC METALS. D. Kuhlmann-Wilsdorf and R. Maddin (Pennsylvania. Univ., Philadelphia. School of Metallurgical Engineering) and H. G. F. Wilsdorf (Franklin Inst. Labs. for Research and Development, Philadelphia). Oct. 15, 1960. 59p.

The re-examination of presently available experimental evidence leads to the conclusion that discolorations differ in the ability to absorb or emit point defects by climb. Old dislocations, namely those which have been stationary during aging or annealing treatments, are not easy sources or sinks of vacancies, while new dislocations, i.e. dislocations which have moved during or since annealing treatments, are easy sources and sinks. Further differences exist in the interactions between point defects and dislocations of edge and screw type, and between mixed dislocations of different orientations, as well as between stationary or slowly moving and fast moving dislocations. The major experimental results on the phenomenon of quench hardening reflect the multiplicity of types of interactions between dislocations and vacancies. Possible explanations are given for the peculiar tangles consisting of kinked and intertwined dislocations often found in face-centered cubic (fcc) metals, for the generation of small dislocation loops in deformed annealed material as well as their partial elimination in quenched or irradiated specimens, for the typical slip line structure, and for the occurrence of overshooting in quenched or irradiated material. Quenched or irradiated pure fcc metals are obviously greatly affected by the presence of vacancies in supersaturation. On the other hand, it is known that point defects are generated during slip, and also that, for deformed fcc pure metals, the dislocation configurations in both types of specimens are quite similar to each other. The conclusion is that the plastic behavior of annealed pure fcc metals and single crystals is also greatly influenced by vacancies and that theories of the plastic properties of metals must take this into consideration. It is further believed that the different mechanisms of interactions between point defects and dislocations play an important role in metal fatigue. (auth)

17321 (TID-12466) SWELLING OF URANIUM. Quarterly Progress Report No. 1. (Brussels. Centre d'Etude de l'Energie Nucleaire). Dec. 1960. 43p. AEC 204/Euratom 253

A research program for finding out whether nucleation of bubbles on dislocations in the rate-controlling process in irradiation swelling of U is described, and pertinent literature is surveyed. The program will be carried out by examining irradiated metal films with the electron microscope, and various methods for preparing thin metal films are reviewed. Experimental results on the preparation and examination of Pt, Nb, Zr, and U films are presented. Pt and Nb films were easily prepared and showed dislocations, while oxide layers formed on Zr films and most of the U films melted under electron microscopic examination. (D.L.C.)

17322 (TID-12476) INVESTIGATION ON ALLOYS OF ZIRCONIUM WITH NIOBIUM AND/OR SILICIUM IN VIEW OF THEIR USE AS SHEATHING MATERIAL IN WATER COOLED REACTORS. Euratom Research Assignment. First Quarterly Report for the Period April 1–June 30, 1960. K. Anderko, H. Richter, and H.-W. Schleicher (Metallgesellschaft A. G., Frankfurt am Main). July 18, 1960. 23p. AEC 72/Euratom 79

Samples were prepared for an investigation of Zr–Nb, Zr–Nb–Sn, and Zr–Si alloys. The Zr–Nb alloys with 1 and 3% Nb, respectively, were subjected to numerous heat treatments. The effects of these treatments on the corrosion resistance of the alloys were determined by 14 days exposure to steam at 400°C and 200 atm. The first results indicated that the samples which had the highest resistance to corrosion were those that were annealed in the α range. The resistance to corrosion decreased if annealing was carried out in the β or in the $\alpha + \beta$ range. (auth)

17323 (TID-12477) INVESTIGATION ON ALLOYS OF ZIRCONIUM WITH NIOBIUM AND/OR SILICON IN VIEW OF THEIR USE AS SHEATHING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Euratom Research Assignment. Second Quarterly Report for the Period July 1 to September 30, 1960. K. Anderko, W. Jung-König, H. Richter, H.-W. Schleicher, and U. Zwicker (Metallgesellschaft A. G., Frankfurt am Main). Oct. 17, 1960. 47p. AEC 72/Euratom 79

An investigation was made of the constitution of Zr–Nb alloys. It was observed that the solubility of niobium in α-zirconium was highest at about 590°C in alloys containing either spongy or iodide zirconium. The maximum solubility of niobium was of the order of 1.5 to 2% in spongy zirconium, whereas it reached slightly over 2% for iodide zirconium. The temperature of the monotectoid reaction was found to be around 590°C for alloys prepared with spongy zirconium. A separation of martensitic platelets took place when alloys with a niobium content of 7.5 to 17% were quenched in water. Comparative corrosion tests were continued. It appeared from these tests that the resistance to corrosion is definitely related to the final annealing temperature and thus also to texture. Some of the alloys were subjected to tensile tests at room temperature and up to 450°C. (auth)

17324 (TID-12478) INVESTIGATION ON ALLOYS OF ZIRCONIUM WITH NIOBIUM AND/OR SILICON IN VIEW OF THEIR USE AS SHEATHING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Euratom Research Assignment. Third Quarterly Report. K. Anderko, W. Jung-König, H. Richter, H.-W. Schleicher, and U. Zwicker (Metallgesellschaft A. G., Frankfurt am Main). Jan. 5, 1961. 55p. AEC 72/Euratom 139

The temperature dependence of the solubility of niobium

in the mixed crystal of α-zirconium was determined. The separation of martensitic platelets in alloys with niobium contents ranging between 7.5 and 17% when they were quenched in water was found to be due to the presence of hydrogen. The comparative corrosion tests in steam were extended. An investigation of the hydrogen absorption of some of the alloys during the corrosion process indicated lower absorption values than those observed for Zircaloy-2. It was found that annealing below the monotectoid range had a particularly favorable influence on the corrosion resistance of the alloys. A study was begun on the variations in length of zirconium alloys subjected to alternating temperatures. (auth)

17325 (TID-12542) EFFECTS OF ANNEALING ON THE STRUCTURE OF PYROLYTIC GRAPHITE. E. R. Stover (General Electric Co. Research Lab., Schenectady, N. Y.). Nov. 1960. 26p. (60-RL-2564M)

Pyrolytic graphite contains sheets of disordered graphite layers arranged in small crystals separated by tilt boundaries, so that continuous atomic planes may be wrinkled. Upon heating to a critical temperature, ordering between layers leads to an effective straightening of the sheets. This process was studied in a variety of pyrolytic deposits by annealing to successively higher temperatures. Isothermal transformation was followed in one case by observing dimensional changes during annealing. Three stages of annealing are distinguished, and deposits are classified according to the temperatures at which different amounts of transformation occur. (auth)

17326 (TID-12600) PHYSICAL METALLURGY OF UNCOMMON METALS. Robert E. Ogilvie and John T. Norton (Massachusetts Inst. of Tech., Cambridge). Apr. 25, 1961. Contract AT(30-1)-981. 23p.

Incremental couples at 10% intervals across the U-Nb binary system were prepared and diffused. Irradiation damage of nickel single crystals bombarded with 3-Mev electrons from a Van de Graaff generator were studied by Kossel line techniques. It was concluded that most defects anneal out below room temperature and all anneal out below 400°C. The cold-rolled texture of tantalum is described by (200) and (110) pole figures. This texture may be approximated by the ideal orientations, {112} <011>, {100} <011>, and {111} <112>. The directionality of Young's modulus, yield strength, and tensile strength of tantalum is also presented. The effects of thermal gradients on the transformation kinetics and diffusion in U–10 wt.% Mo were investigated. The alloy U(Fe,Mn) was found to be paramagnetic from 480 to 10°K. The remanent magnetization of hematite along particular directions in the (111) plane and along the [111] direction of a rectangular prism was measured during a complete cycle of temperature change between 488 and 77°K. The remanent-temperature relationship and the thermal hysteresis effect were also measured. The concept of space filling was developed for presenting geometrical relationships of different crystal structures. The structure of the pseudo-binary system $ReTi_2$–$TiSi_2$ was investigated. (M.C.G.)

17327 (VDIT-34) SOME PROPERTIES OF NIOBIUM AND NIOBIUM ALLOYS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Mar. 1961. 17p.

Fifty-three abstracts of publications on niobium and niobium alloys are presented under the following headings: general, solid state physics and structure, mechanical properties, corrosion and oxidation, radiation effects, and protective coatings. (D.L.C.)

17328 (WADD-TN-60-288) PHASE RELATIONSHIPS IN TANTALUM-RICH TANTALUM–RUTHENIUM ALLOYS AT 1500°C. Period covered: May 1960 to November 1960. C. S. Hartley, W. L. Baun, and D. W. Fisher (Wright Air Development Div. Materials Central, Wright-Patterson, AFB, Ohio) and E. J. Rapperport (Nuclear Metals, Inc., Concord, Mass.). Nov. 15, 1960. 22p.

Arc-melted and homogenized alloys of tantalum and ruthenium containing 10, 20, 30, 40, 45, and 50 at.% ruthenium were heat-treated for 168 hours at 1500°C and quenched. Structure and lattice parameters of the alloys were determined by x ray powder photographs. Solubility of ruthenium in tantalum at 1500°C lies between 20 and 30 at.%. An intermediate phase having the stoichiometric composition TaRu exists from 20 to 30 at.% ruthenium to 48 ± 2 at.%. Room temperature structure of TaRu is based on CsCl (Type B2) at 30% ruthenium composition, but distorted CsCl at the 40 and 45 at.% compositions. Complete x ray data for all alloys are presented. (auth)

17329 (WAPD-239) SOME OBSERVATIONS ON THE CAUSES AND PREVENTION OF EXAGGERATED GRAIN GROWTH IN ZIRCALOY-CLAD PRESSURE-BONDED OXIDE PLATE FUEL ELEMENTS. D. Jaffee (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1961. Contract AT-11-1-GEN-14. 33p.

Exaggerated grain growth due to critical strain was observed in the Zircaloy-4 components of oxide plate fuel elements isostatically pressure bonded and was considered to be undesirable. An investigation was undertaken using both solid and oxide plate samples to determine the conditions leading to critical strain and means of preventing it. In solid samples the critical strain occurred at reductions of 6 and 4% for heat treatments of 4 hours at 1382 and 1550°F, respectively. In oxide plate samples exaggerated grain growth was eliminated by the use of Zircaloy components cold rolled 25% and annealed for 4 hours at 700°F in conjunction with a pressurizing temperature of 600 to 700°F. In addition, significant effects of bonding temperature on the grain-growth characteristics of material subjected to critical strains were observed, and a tentative explanation for these based on the alpha-to-beta transformation in Zircaloy is offered. (auth)

17330 (AEC-tr-4325) HYDRIDES OF RARE EARTH METALS AND THEIR PRACTICAL APPLICATIONS. V. I. Mikheeva (Mikheyeva) and M. E. (Ye) Kost. Translated by J. Woroncow from Chapt. 4, Sect. 4 of "Rare Metals and Their Alloys," (A Publication of the Publishing House of Literature on Metallurgy, Moscow, 1960). 8p. (XDC-60-10-63)

A discussion is given of the properties of rare earth element hydrides by studying cerium hydride. Results are presented of the preparation and property study which would be of interest to metallurgists. In performing the experiments, 97% pure metallic cerium with 3% admixture of other rare earths was used. (auth)

17331 (AEC-tr-4326) PROPERTIES OF VANADIUM, COLUMBIUM AND THEIR ALLOYS. V. V. Baron and E. (Ye) M. Savitskii (Savitskiy). Translated by J. Woroncow from Chapt. 3, Sect. 6 of "Rare Metals and Their Alloys," (A Publication of the Publishing House of Literature on Metallurgy, Moscow, 1960). 17p. (XDC-60-10-106)

An investigation was made of microstructure and properties of carbothermal vanadium with different degrees of purity, and Cr–V and Mo–V alloys. Effects of carbon, nitrogen, and oxygen admixtures on the mechanical properties were studied. The properties and structure of Cr–V alloys are discussed. A study was made of the recrystallization of

niobium, and the alloying effects of boron, silicon, vanadium, titanium, chromium, zirconium, molybdenum, tantalum, tungsten, lanthanum, and Misch metal on the recrystallization temperature. The effects were studied on hardness, plasticity, and technological properties in relation to machining and heat-treatment conditions. The properties and structure of Al–Nb and Nb–Sn alloys are discussed. (auth)

17332 (AEC-tr-4558) STUDY OF THE SELF-DIFFUSION OF URANIUM IN THE γ PHASE. Y. Adda and A. Kirianenko. Translated by James F. Murdock (Oak Ridge National Lab., Tenn.), from J. Nuclear Materials, 2: 120-6(1959). 14p.

A study of self diffusion of uranium was made in the range of temperatures between 800 and 1050°C, beginning with diffusion couples made of natural uranium and U^{234}-enriched uranium. The specimens were sectioned on a precision lathe after treatment, and the alpha emission (in thick layer) of the sectioned face was measured in an ionization chamber. From the activity-penetration curves established in this way, the self-diffusion coefficients of uranium in the γ phase were determined as well as the activation energy ($Q = 27.5$ cal/mole) and the frequency factor ($D_0 = 1.8 \times 10^{-3}$ cm^2/sec). (auth)

17333 (UCRL-Trans-653(L)) RATE OF TWINNING IN ZINC SINGLE CRYSTALS. Rolf Siems and Peter Haasen. Translated from Z. Metallk., 49: 213-20(1958). 25p.

Electrolytically polished zinc single crystals of suitable orientation were strained under the microscope. The formation and growth of twins was observed cinematographically (at 2000 frames per second). Normally, the first twins appear at shear stresses of about 400 g/mm^2. But with crystals whose orientation excludes a basal slip, no twins generally appear up to stresses of 1 kg/mm^2. This indicates that a high stress concentration is necessary for nucleation, which can be produced by a preceding slip. A dislocation mechanism for this nucleation is discussed. The various stages in the growth of a twin were discussed. These permit a qualitative understanding of the surface phenomena observed. The rates of growth in thickness for twins as measured are much smaller than were expected in frictionless motion of the dislocations. The magnitude of the frictional stresses acting on the twin dislocations R_v (v = dislocation velocity) was estimated from the measurements. A frictional stress was found for twinning in zinc of $\tau^* = R_c = 400$ kg/mm^2 (c = velocity of sound). (auth)

17334 (UCRL-Trans-657(L)) CONTRIBUTION TO THE STUDY OF THE PROPAGATION OF LUDERS BANDS IN SOLID SOLUTIONS. J. Caisso and J. Micard. Translated from Mém. sci. rev. mét., 57: 57-61(1960). 12p.

A study was made of the propagation of plastic waves in the midst of a solid solution, submitted to an increasing deformation, using the Portevin-Le Chatelier phenomenon which consists of hooks and steps on tensile curves of deformed metallic alloys under certain speed and temperature conditions. Variations in length, width, and thickness of the test specimens had no effects on test results. Each Luders band developed in a limited portion of the test piece because it stopped as soon as the strain passed from one value to a lower one. (M.C.G.)

17335 THE EFFECT OF PRESSURE ON THE AGE-HARDENING CHARACTERISTICS OF A COPPER–BERYLLIUM–NICKEL ALLOY. V. A. Phillips (Wright Air Development Center, Wright-Patterson AFB, Ohio). Acta Met., 9: 216-24(Mar. 1961).

The effect of pressure during heat-treatment on the optical microstructure and microhardness of a commercial copper–2.1 per cent beryllium–0.4 per cent nickel alloy was studied. It was found that the application of 69 to 75 katm pressure during aging at about 390°C reduced the growth rate of discontinuous precipitate nodules by a factor of about 18, and reduced the rate of general precipitation by a factor of about 5 without significantly changing the peak hardness. Pronounced localized precipitation occurred on aging under high pressure. The application of 69 to 75 katm pressure during solution treatment at about 825°C apparently substantially reduced the solubility of beryllium in copper, in agreement with theoretical prediction, and gave an unusually fine-grained structure due to the inhibition of grain growth. (auth)

17336 THERMODYNAMIC PROPERTIES OF URANIUM–BISMUTH ALLOYS. A. Cosgarea, Jr. (Univ. of Oklahoma, Norman), E. E. Hucke, and D. V. Ragone. Acta. Met., 9: 225-36(Mar. 1961).

Thermodynamic properties of uranium–bismuth alloys are determined by measuring the vapor pressure of bismuth in equilibrium with the condensed phase. Classical methods based on the rate of sublimation, rate of evaporation, or rate of effusion can not be used since each method requires an accurate knowledge of the molecular weight of the vapor. The molecular weight of bismuth is not accurately known, but Bi and Bi_2 species are present. An optical absorption technique is used to determine the concentration of each species independently. This method consists of measuring concentrations in a vapor by the quantity of light absorbed at certain characteristic frequencies by the species in the vapor. The amount of each species present, which is related to the pressure, is determined by measuring the diminution of intensity at 3067 and 2731 A. The amount of radiation absorbed is dependent on the thickness of the vapor space and the concentration of the bismuth vapor. The thermodynamic activity of bismuth is measured at temperatures from 725 to 875°C in the U_3Bi_4 + UBi_2, UBi_2 + liquid, and the one-phase liquid regions. In order to obtain measurable quantities in the regions UBi + U and UBi + U_3Bi_4 it is necessary to work at temperatures from 800 to 1000°C. From a measure of the activity of bismuth, the activity of uranium is calculated for the entire system. The liquid uranium–bismuth alloys are found not to be regular solutions. The Henry's law parameter (3.49×10^{-3} at 1064°K) is found to be valid for uranium concentrations of less than 2 mole % uranium. From a complete knowledge of the activities of uranium and bismuth in the system the partial molar quantities and integral molar quantities are calculated at five temperatures: 1018, 1041, 1064, 1089, and 1115°K. (auth)

17337 TWINNING IN ZIRCONIUM. D. G. Westlake (Argonne National Lab., Ill.). Acta Met., 9: 327-31(Apr. 1961).

Twinning in zirconium may or may not occur by a dislocation mechanism. Two of the observed twinning modes can be explained by the use of relatively simple dislocation models. For a third mode, however, the model is very complex. (auth)

17338 ON THE HAZIGUTI'S AND OTHERS THEORY OF RADIATION GROWTH OF α-URANIUM. Yu. N. Sokurskii. Atomnaya Energ., 10: 274-5(Mar. 1961). (In Russian)

The Haziguti, Sakari, and Sugai theory on the mean deformation for various thermal peak doubling of the {130} and $\{3\bar{1}0\}$ type in α-uranium growth, based on the postulation that the elongation proceeds in the (0.0) direction and contraction in the (100) direction, is challenged. The various possible deformations plotted along {130} and $\{3\bar{1}0\}$ show the impossibility of crystal elongation along (010) by doubling at {130} and $\{3\bar{1}0\}$. Considering the doubling process takes

place at the speed of light c, the maximum magnitude is equal $\sim r_c = 10^{-6}$ cm. Such doubling can hardly be stable; hence, the theory based on displacement and atom "mixing" is more feasible. (R.V.J.)

17339 PHASE COMPOSITIONS OF NICKEL-RICH ALLOYS IN THE Ni–Mo–B SYSTEM. P. T. Kolomytsev and N. V. Moskaleva. Atomnaya Energ., 10: 276-7(Mar. 1961). (In Russian)

An analysis was made of nickel base alloys containing 22 to 23 at.% Mo, and 25 to 33 at.% B. The alloys were annealed at 1000°C and cooled in air. The microstructure and isothermal cross sections at 1000°C are shown. (R.V.J.)

17340 THE EFFECT OF MECHANICAL STRESSES ON THE SECONDARY ELECTRON EMISSION FROM BERYLLIUM OXIDE. A. M. Tyutikov. Doklady Akad. Nauk S.S.S.R., 136: 1063-5(Feb. 11, 1961). (In Russian)

Samples were prepared by vacuum sputtering beryllium onto a steel or beryllium bronze backing with subsequent oxidation to form an oxide film several hundred angstroms thick. The oxide film was put under compressive or tensile stress with the use of a special bending jig. A beam of primary electrons (400 ev) was directed toward the center of the sample, and measurements of the secondary electron emission were carried out in a spherical condenser in a vacuum of 5×10^{-7} mm Hg. Two maxima of the electron velocity of the secondary emission were noted. The first maximum is due to true secondary electrons whose intensity was observed to decrease with increasing stress on the beryllium oxide film. The second maximum corresponds to electrons with "insufficient energy". This maximum broadens out with an increase in stress. Removal of the stress ordinarily restored the sample to its original condition, but if the compressive stress exceeded 2 to 3 mm on the gage for a sample 0.5 mm thick, the distortion in the volt-ampere characteristic of the secondary emission became permanent. It is postulated that lattice defects which originate during deformation of the beryllium oxide film act as electron traps for secondary electrons. (TTT)

17341 EFFECTS OF NIOBIUM OXIDE COMPOUNDS ON FRACTURE RESISTANCE IN LOW CARBON STEEL. L. M. Belova, O. D. Moldavskii, and A. P. Pronov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 119-21(Jan.-Feb. 1961). (In Russian)

An attempt is made to determine the composition of niobium oxide compounds, the character of their distribution, the quantity, and the effects on fracture resistance in 0.4 to 4.5% Nb Steel. The chemical composition of ferroniobium used in alloying was 54.40% Nb, 11.29% Si, 5.17% Al, 0.09% C, 0.013% S, 0.11% P, the balance Fe. The microstructure of cast alloyed steel shows a strong niobium effect (starting with 1%) on structure and on the tendency to hot-fracture. Up to 0.5% Nb is the most effective in producing hot-fracture resistance. A certain improvement in crack resistance is also observed with Nb contents over 2%. (R.V.J.)

17342 SINGLE AND DOUBLE PHASE REGION BOUNDARIES IN W–C–Co AND W–C–Ni SYSTEMS. I. N. Chaporova and E. A. Shchetilina. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 126-32 (Jan.-Feb. 1961). (In Russian)

The maximum solubility of tungsten in solid solutions of cobalt increases steadily from 9.39 to 19.65 wt.% as the carbon content is reduced from 0.61 to 0.35 wt.%. The single-phase region in W–C–Ni systems with W contents to 14.5% takes place with the same carbon content ~0.60 to 0.55%. With additional tungsten (up to 19.5%) the solubility of carbon in nickel drops to 0.5% wt.%, and with 24.5% W to less than 0.5 wt.% C. The two-phase regions WC + Co and WC + Ni in W–C–Co (Ni) systems at the hardening point are found below the geometric lines of Co–WC and Ni–WC. The carbon rich boundary in the WC + Co phase is distributed along the Co–WC line, and in the W–C–Ni system it passes below the corresponding Ni–WC line. The carbon poor boundaries of the two-phase regions are distributed in both systems along the WC–Co and WC–Ni cross sections. Moreover, the lack of carbon in W–Ni alloys is considerably more pronounced than for W–C–Co systems. (R.V.J.)

17343 PROPERTIES AND PHASE STUDIES OF BORON AND CARBON SYSTEMS. N. N. Zhuravlev, G. N. Makarenko, G. V. Samsonov, V. S. Sinel'nikova, and G. C. Tsebulya. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 133-41(Jan.-Feb. 1961). (In Russian)

The preparation of pure B–C systems is described, and the phase composition and properties of systems with C contents of 4.5 to 90 wt.% are investigated. The presence of $B_{12}C_3(B_4C)$ was verified, and a new boron-rich compound $B_{12}C$ was found. A preliminary phase composition was determined, and two constitution diagram variations are suggested for systems with up to 50 wt.% C. A wide range of boron solubilities into carbon is suggested. The relation between the electrical properties and crystal structure was determined, and the change in B_4C from a semiconductor to a conductor at 1400 to 1500°C was verified. (R.V.J.)

17344 VAPOR PRESSURE AND THE EVAPORATION RATE OF SOME HIGH-MELTING COMPOUNDS IN VACUUM AT ELEVATED TEMPERATURES. A. S. Bolgar, T. S. Verkhoglyadova, and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 142-5(Jan.-Feb. 1961). (In Russian)

The evaporation range and vapor pressure of TiC, ZrC, HfC, NbC, Cr_3C_2, TiB_2, ZrB_2, CrB_2, SrB_6, AlB_{12}, TiN, NbN, Ta_2N, and $MoSi_2$ were determined at 1100 to 2000°C by the Langmuir method, and the heats of evaporation were calculated. It was found that all the compounds evaporate as molecular complexes except AlB_{12}, which dissociates by expelling aluminum. (R.V.J.)

17345 EFFECT OF ALLOYING ON THE MECHANICAL PROPERTIES OF NIOBIUM. R. T. Begley and J. H. Bechtold (Westinghouse Research Labs., Pittsburgh). J. Less-Common Metals, 3: 1-12(Feb. 1961). (In English)

The effects of additions of those elements which are near neighbors in the periodic table on the mechanical properties of niobium are studied. These effects vary widely and follow no simple general rule. (auth)

17346 PRELIMINARY MEASUREMENTS ON THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF MOLYBDENUM, NIOBIUM, TANTALUM AND TUNGSTEN. R. P. Tye (National Physical Lab., Teddington, Middx., Eng.). J. Less-Common Metals, 3: 13-18(Feb. 1961). (In English)

The thermal conductivity and electrical resistivity of the four metals are measured to the order of 300°C and the electrical resistivity measurements are extended to above 1300°C. The results are presented together with a discussion on the behavior of the Lorenz function for the materials and some comparison is made with other data at temperatures above 0°C. (auth)

17347 THE EFFECT OF OXYGEN ON THE MECHANICAL PROPERTIES OF ZONE-REFINED NIOBIUM. M. J

Leadbetter and B. B. Argent (Univ. of Sheffield, Yorks, Eng.). J. Less-Common Metals, 3: 19-28(Feb. 1961). (In English)

The yield point behavior of niobium containing varying quantities of oxygen is investigated. Oxygen raises the yield stress at 293°K and 77°K. Twinning is observed in zone-melted niobium at 77°K but this is inhibited by oxygen additions. (auth)

17348 THE CONSTITUTION OF THE CHROMIUM-NIOBIUM-SILICON SYSTEM. H. J. Goldschmidt and J. A. Brand (B.S.A. Group Research Centre, Kitts Green, Birmingham, Eng.). J. Less-Common Metals, 3: 34-43(Feb. 1961). (In English)

The constitutional diagram of the alloy system Cr-Nb-Si is investigated for a 1000°C section, as well as some of the properties of the alloys. X-ray diffraction analysis is used upon argon arc melted alloys. Some modifications are proposed to the known Cr-Si binary system. (The Nb-Si side was dealt with in a previous paper, the Cr-Nb side in a concurrent one.) The ternary diagram presented is highly complex, involving, in addition to eleven phases of binary origin, five new ternary compounds; three of the latter possess considerable homogeneity ranges: one is a new Laves phase, another a βNb_5Si_3 isomorph, stabilized to lower temperatures through Cr addition. Melting points and oxidation resistance of the alloys are given, and the latter property, though limited to a 1000°C, I-h survey, indicates promising areas for further study. (auth)

17349 THE CONSTITUTION OF THE CHROMIUM-NIOBIUM-MOLYBDENUM SYSTEM. H. J. Goldschmidt and J. A. Brand (B.S.A. Group Research Centre, Kitts Green, Birmingham, Eng.). J. Less-Common Metals, 3: 44-61 (Feb. 1961). (In English)

The ternary system Cr-Nb-Mo is studied from the aspect of phase constitution, as well as of some of the alloy properties; the wider implications are pointed out, both fundamentally and from the viewpoint of possible application in high temperature and age-hardening materials. Argon arc-melted alloys were examined for a 1000°C equilibrium by x-ray powder-photography. The diagram derived is characterized by an extensive miscibility bay within the primary single-phase (α) field, based on molybdenum. Lattice segregation effects are involved, the high temperature α matrix dividing into two isomorphs of different lattice dimensions: this entails various intermediate stages, with lattice strains and age-hardening effects developing; the Laves phase Cr_2Nb enters as a further precipitant. Spacing contours and tie-lines are given. The Cr-Nb binary system is determined for various temperatures, and the new diagram proposed modifies previous data in certain respects. Melting points, some mechanical properties and oxidation rates are given, and interesting composition areas of improved oxidation resistance are indicated; oxide constitution studied on the alloys is considered in this light. (auth)

17350 THE EFFECT OF STRAIN RATE, AND HEAT TREATMENT, ON THE TENSILE PROPERTIES OF EXTRUDED BERYLLIUM RODS BETWEEN 25 AND 600°C. A. B. Brown (Babcock and Wilcox, Renfrew, Scotland), F. Morrow, and A. J. Martin. J. Less-Common Metals, 3: 62-88(Feb. 1961). (In English)

Extruded bars of beryllium ingot and sintered powder are tensile-tested at temperatures between 25 and 600°C. The fracture mode is found to depend on the temperature and the strain rate, and the incidence of repeated yield phenomena is noted between 300°C and 500°C. The ductility at 600°C of the more impure pebble ingot material is found to be particularly affected by heat treatments, which, from their effect on the yield phenomena and on hot-hardness measurement, appear to promote precipitation of certain impurities from solution. (auth)

17351 DIFFUSION OF LANTHANIDES AND ACTINIDES FROM GRAPHITE AT HIGH TEMPERATURES. C. J. Orth (Los Alamos Scientific Lab., N. Mex.). Nuclear Sci. and Eng., 9: 417-20(Apr. 1961).

Measurements are made of the diffusion losses of lanthanide and actinide elements from graphite at temperatures from 1600 to 2600°C. In the lanthanide series, a close correlation is observed between the diffusion rates from graphite and the boiling points of the metals. Where boiling point measurements permit comparison, a similar correlation is also noted for the actinides. The most volatile of these elements are the ones for which lower oxidation states can be attained chemically [Sm(II), Eu(II), Yb(II), and possibly Am(II)]. Conversely, those elements which exhibit oxidation states higher than (III) show high-temperature stability in graphite. Although the diffusion loss of uranium is not negligible above 2100°C, no loss is detected from a small graphite pin heated for four hours at 2050°C; under the same conditions, about 50% of the plutonium is lost. The possible significance of these measurements to high-temperature reactor design is discussed. (auth)

17352 HIGH-FREQUENCY SURFACE THERMAL FATIGUE CYCLING OF INCONEL AT 1405°F. J. J. Keyes, Jr. and A. I. Krakoviak (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 9: 462-74(Apr. 1961).

The effects on Inconel of the application of relatively high-frequency thermal oscillations are studied, under conditions such as to generate significant transient stress in the surface fibers. Thermal instabilities of this nature may be generated in the operation of certain types of nuclear reactors. Fatigue-type cracking is observed in 214 hr at 1.0 cps for a surface temperature amplitude of ±64°F (17,800 psi maximum elastic surface stress); incipient cracking occurs in 23 hr at 0.4 cps for an amplitude of ±104°F (31,300 psi). Application of ±46°F surface temperature oscillations (12,800 psi) at 1.0 cps for 612 hr produces accelerated intergranular corrosion in a fused salt environment. These results are correlated in terms of the maximum calculated elastic surface stress. (auth)

17353 SOLID STATE ELECTROLYSIS IN YTTRIUM METAL. J. M. Williams and C. L. Huffine (General Electric Co., Evendale, Ohio). Nuclear Sci. and Eng., 9: 500-6 (Apr. 1961).

Yttrium metal rods of commercial purity (3300 ppm O_2) were heated to 1230 to 1370°C for 200 hr in static argon by passage of direct current. Chemical and metallographic examination indicated that oxygen and several metallic impurities (Fe, Mn, Ni, B, Ti, Co) had migrated extensively to the anode with the oxygen content near the cathode being reduced by 80%. The metal near the cathode was ductile and could be cold rolled to 65% reduction without edge cracking. These experiments are the first successful attempt to utilize electrolysis of a solid metal as a purification technique. (auth)

17354 GRAPHITE-MATRIX FUEL BODIES. T. M. Benziger and R. K. Rohwer (Los Alamos Scientific Lab., N. Mex.). Nucleonics, 19: No. 5, 80; 82; 84-5(May 1961).

Uses of graphite as matrices for fuel elements are studied. Methods of producing graphite matrix elements, especially by a screw extrusion process, are discussed. Methods for incorporating the fuel into the graphite, such as blending before graphitization and impregnation, are also examined. Reactor uses of these elements, canned and uncanned, are described. (T.F.H.)

7355 EQUILIBRIUM THERMODYNAMIC PROPERTIES OF A VACANCY IN A F.C.C. LATTICE WITH CENTRAL INTERACTION. G. F. Nardelli (Centro Studi Nucleari, Ispra, Italy) and A. Repanai Chiarotti. Nuovo Cimento (10), 18: 1053-71(Dec. 16, 1960). (CNI-87) (In English)

The influence of a vacant lattice site on the thermodynamic equilibrium properties of crystals is investigated at various temperatures ranging from zero to the melting point. The change of vibrational properties is evaluated by means of an Einstein model. The study of the elastic relaxation is extended to a vibrating lattice, and the vibrational free energy is evaluated taking into account the displacement field. The image forces due to the vacancy are discussed including the cubic tensors in the expression of the potential energy. Numerical results are reported for crystals of inert gases. (auth)

7356 MANGANESE RARE EARTH COMPOUNDS WITH THE $MgZn_2$ STRUCTURE. J. H. Wernick and S. E. Haszko (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. and Chem. Solids, 18: 207-9(Feb. 1961). (In English)

Two new AB_2 compounds, $ErMn_2$ and $TmMn_2$, having the $MgZn_2$ structure are reported. The transition from the cubic Mn rare earth compounds to the hexagonal compounds is discussed. Crystallographic data for these two compounds and for $HfMn_2$ having the same structure are reported. (auth)

7357 EFFECT OF HYDROGEN ON THE TENSILE PROPERTIES OF IODIDE VANADIUM. A. L. Eustice and O. N. Carlson (Iowa State Univ. of Science and Tech., Ames). Trans. Met. Soc. AIME, 221: 238-41(Apr. 1961). (IS-97).

The tensile properties of iodide vanadium were determined as a function of hydrogen concentration. It was shown that the presence of 10 ppm H is sufficient to cause embrittlement of vanadium over a limited temperature range. The temperature of the observed ductility minimum is approximately −100°C, this being a function of strain rate and hydrogen concentration. The yield stress of hydrogenated vanadium is raised sharply in the brittle temperature range. (auth)

7358 A STUDY OF THE SPECTRAL EMISSIVITIES AND MELTING TEMPERATURES OF OSMIUM AND RUTHENIUM. R. W. Douglass and E. F. Adkins (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 221: 248-9(Apr. 1961).

The variation of the spectral emissivity of osmium and ruthenium with temperature can be expressed by the following relations: osmium, $\log_{10}\epsilon_{\lambda=0.655} = 9510\ [157.8 - 0.160\ T/T(0.840\ T + 157.8)]$ and ruthenium, $\log_{10}\epsilon_{\lambda=0.655} = 9510\ [172.0 - 0.183\ T/T\ (0.817\ T + 172.0)]$ where T is the absolute temperature. The melting temperatures of osmium and ruthenium were determined as 3010° ± 10° and 2250° ± 10°C, respectively. (auth)

7359 A STUDY OF THE Ti−Cu−Zr SYSTEM AND THE STRUCTURE OF Ti_2Cu. Elmars Ence (Republic Aviation Corp., Farmingdale, N. Y.) and Harold Margolin. Trans. Met. Soc. AIME, 221: 320-22(Apr. 1961).

The partial isothermal section of the Ti−Cu−Zr system at 750°C is studied. The crystal structure of Ti_2Cu is determined as tetragonal and when expressed as face-centered tetragonal, a = 4.164 Å, c = 3.611 Å, and c/a = 0.867. (auth)

7360 THE EFFECT OF COPPER, NICKEL, IRON, AND CHROMIUM ON THE TENSILE PROPERTIES OF PREFERENTIALLY ORIENTED BERYLLIUM SHEET. F. M. Yans, A. D. Donaldson, and A. R. Kaufmann (Nuclear Metals, Inc., Concord, Mass.). Trans. Met. Soc. AIME, 221: 364-70(Apr. 1961).

Beryllium was mixed by powder metallurgical techniques with copper, nickel, iron, and chromium, respectively, to form beryllium-rich binary alloys which were then extruded and rolled transverse to the extrusion direction. The effect of each alloying element was determined by tensile testing. In solid solution, small amounts of iron and nickel had an embrittling effect, while copper in solution increased the strength but had no effect on ductility. The effect of chromium was complicated and not readily explainable. Observations concerning the planes and modes of fracture are made. (auth)

17361 EFFECT OF ENVIRONMENT ON THE MECHANICAL PROPERTIES OF METALS. H. E. McCoy, W. R. Martin, and J. R. Weir (Oak Ridge National Lab., Tenn.). p.163-76 of "Proceedings of the Institute of Environmental Sciences National Meeting, April 5,6,7, 1961, Washington, D. C." Illinois, Inst. of Environmental Sciences, Mt. Prospect.

The influence of service environment on the mechanical properties of metals is shown to be of practical significance. The relative importance of factors such as chemical reactivity of the material with service environment, effect of environment on surface and grain-boundary energies, temperature, and the ratio of surface area-to-volume is discussed. Methods for carrying out mechanical property tests in simulated service environments at elevated temperatures are illustrated. The effects of an air environment on the creep and stress-rupture properties of type 304 stainless steel and Inconel over the temperature range of 1300 to 1700°F are presented. Investigation of the effects of the component gases, oxygen, and nitrogen, shows that the strengthening effect found in type 304 stainless steel tested in air is associated primarily with an increase in the nitrogen content. The increase in the stress-rupture life of Inconel tested in air is due primarily to the retarding effect which air has on the onset of third-stage creep. (auth)

Radiation Effects

17362 (AD-243561) DEVELOPMENT AND EVALUATION OF ELECTRON TUBE-GLASSES RESISTANT TO RADIATION DAMAGE. Second Semi-Annual Progress Report, November 1, 1959 to May 1, 1960. R. Spencer (Chatham Electronics. Div. of Tung-Sol Electric Co., Livingston, N. J.). Contract DA-36-039-SC-78312. 21p.

Dummy bulbs with and without leads of Owens-Illinois 51-26 boron-free glass, and Corning 7720 and 1723 glass were exposed to an integrated thermal neutron flux of 10^{18} NVT. Examination revealed far less deleterious effects from neutron bombardment on the boron-free glass than on other types, and more damage was noted on enclosures which were not annealed than on those which were annealed. A few tubes of type 5R4WGA and one ionization gauge tube of type VG1A cracked when exposed to 10^{16} NVT. Ionization gauges enclosed in 7720 and 1723 glass show an increase in gas pressure of from 10^{-6} mm before irradiation to 5×10^{-3} mm after exposure to 10^{16} NVT. All exposures were monitored by cadmium-aluminum activation foils as dosimeters, and discrepancies are still found to exist between the estimated and true flux, although recent exposures were within a factor of three compared with earlier exposures which were off by a factor of ten in some cases. (auth)

17363 (AD-246101) ELECTRON BOMBARDMENT OF THE SILICON UNIPOLAR TRANSISTOR (thesis). John

Powell Jones (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1960. 55p.

An investigation of the irradiation resistant qualities of the silicon unipolar transistor is reported. For the investigation, three experimental silicon unipolar transistors were subjected to 1-Mev electrons and a pictorial record was obtained of the static characteristics of each device as the irradiation damage progressed. The investigation revealed that the silicon unipolar transistor does not offer any significant advantage over the bi-polar transistor for circuit applications where resistance to radiation is an important factor. Short summaries of unipolar transistor theory and electron damage to n-type silicon are included. (auth)

17364 (AD-246465) THE EFFECTS OF PULSED NEUTRONS ON INFRARED DETECTORS (thesis). John Curtis Marshall (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1960. 48p.

Lead telluride and lead sulfide cells were bombarded by 14.1-Mev neutrons in pulses of 100 microseconds at 1000 pulses/sec. Noise voltage and the time constant were measured before, during, and after radiation. No change was noticed for a neutron flux of 10^7 neutrons/sec cm^2. Calculations indicate that any effects would be less than, or of the same order of magnitude as noise from other sources and in agreement with experimental results. Semiconductor diodes were used as a check of the experimental apparatus and found to be influenced as expected. (auth)

17365 (CRFD-955) UO_2 IRRADIATIONS OF SHORT DURATION. PART II. A. S. Bain, J. A. L. Robertson, and A. Ridal (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Feb. 1961. 58p. (AECL-1192)

A description is given of the irradiation of fuel specimens in the "Hydraulic Rabbit" of the NRX Reactor. It was deduced that the surface temperature of the fuel increased with increasing diametral clearance on the original assembly. For the particular conditions studied, the effect only became appreciable for an original clearance equal to 1% of the diameter, but then increased rapidly. Under the same conditions the substitution of helium for argon as filling gas had a relatively small effect (about 50°C) on the fuel surface temperature. In both diametral and axial directions the sum of the original clearance and the residual sheath strain is, to a first approximation, constant. Axial expansion of the sheath is decreased by the provision of distributed clearance in the form of dishing of the pellet end faces; the profile of the dishing has a significant effect. The effects of diametral clearance on axial expansion, and vice versa, as well as heat rating and sheath strength on the sheath strains were examined and discussed. (auth)

17366 (CRFD-994) IRRADIATION OF NON-STOICHIOMETRIC URANIUM OXIDE FOR SHORT DURATIONS. A. Ridal, A. S. Bain, and J. A. L. Robertson (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Feb. 1961. 21p. (AECL-1199)

To elucidate the irradiation behavior of non-stoichiometric uranium oxide, specimens containing $UO_{2.12}$ were studied in Hydraulic Rabbit tests. Comparison with similar specimens containing stoichiometric oxide showed that the non-stoichiometric material exhibits more melting and grain growth for the same heat rating. It is deduced that the mean thermal conductivity of $UO_{2.12}$ between 350 and 2800°C during irradiation is ~20% lower than that of $UO_{2.0}$ under similar conditions. For the same heat ratings, the diametral expansion of the $UO_{2.12}$ specimens was greater than that for $UO_{2.0}$, but for similar structural changes in the fuel the expansions were the same. Metallographic examination of the $UO_{2.12}$ showed that oxygen had migrated from the molten core to an annulus at an intermediate temperature. (auth)

17367 (HW-36111(Del.) HYPOTHESIS CONCERNING IRRADIATION EMBRITTLEMENT OF URANIUM. E. C. Wood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 7, 1955. Declassified with deletions May 4, 1960. 6p.

A hypothesis evolved to fit available information on irradiation embrittlement of uranium and to offer a possible solution to the problem is discussed. Experiments suggested that the rate of diffusion of fission products from the grain to the grain boundary is very low. To explain the embrittling effects it was necessary to postulate that the effect of fission products in the grain boundary is less severe than the effect of fission products in the grain. It was therefore hypothesized that uranium having fine grain structure will suffer less embrittlement on irradiation than will uranium with a coarse structure. (M.C.G.)

17368 (HW-43973(Del.)) IRRADIATION OF U–Mg MATRIX FUEL MATERIAL TO HIGH EXPOSURES. M. D. Freshley and G. A. Last (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1956. Declassified with deletions Feb. 19, 1960. Contract W-31-109-Eng-52. 27p.

An experiment designed to evaluate the in-pile performance of the U–Mg fuel material when irradiated to high burnups was completed. Twelve specimens of the fuel material which contained uranium particles that packed 50 volume % uranium in a magnesium matrix were canned in Zircaloy cans and irradiated to 0.1, 0.5, 1.0, and 2.0% burnup of the total uranium atoms. Six of the samples contained a matrix of pure magnesium and 6 contained a matrix of Mg–4 wt.% Si in order to compare the effects of irradiation. Load-deflection curves for the irradiated specimens showed that the material lost most of its ductility as a result of the neutron flux and that the maximum load required for failure increased. Most of the damage caused by irradiation became saturated at relatively low burnups. The results of the bond tests showed a slight decrease in the ultimate strength of the material as the exposure was increased. However, the maximum deflections at failure did not change with exposure. The samples containing an alloy matrix of Mg–0.4 wt.% Si had better boiling water corrosion resistance than samples containing a pure magnesium matrix. The irradiated samples containing an alloy matrix decanned easier than the others. This material was found to be capable of withstanding high specific power generation, was dimensionally stable, relatively resistant to radiation damage and apparently had satisfactory fission product retention properties. (M.C.G.)

17369 (NASA-TN-D-718) IRRADIATION EFFECTS OF 22 AND 240 MEV PROTONS ON SEVERAL TRANSISTORS AND SOLAR CELLS. W. C. Hulten, W. C. Honaker, and John L. Patterson (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Apr. 1961. 28p.

Proton bombardment effects on electronic components are examined as determined from simulation of two portions of the proton spectrum to be encountered in the earth's trapped radiation belts. The experimental data indicate definite detrimental effects on transistors and solar cells but no apparent damage to the types of resistors and condenser tested. The detrimental effects were of two distinct types: transient and permanent. (auth)

17370 EFFECTS OF ELECTRON BOMBARDMENT UPON INORGANIC SUBSTANCES OBSERVED IN AN ELECTRON MICROSCOPE. Helena de Souza Santos (Universidad

São Paulo). Anais acad. brasil. cienc., 32: 333-40(Dec. 31, 1960).

Studies of 36 inorganic substances show that it is possible to have temperatures which can produce melting, sublimation, and chemical decomposition. The morphological alteration which occur inside an electron microscope can be grouped according to or correlated to the phase changes and chemical transformations or decomposition which those substances suffer under the temperature increase. From those observations it was possible to estimate that temperatures of the order of 100 to 200°C were reached under low-intensity beams; temperatures as high as 400°C were reached for higher intensities. (auth)

17371 NATURE OF THE RESIDUAL DEFECTS IN MONOCRYSTALS AFTER NEUTRON IRRADIATION AND DEFORMATION. E. V. Kolontsova. Atomnaya Energ., 10: 227-32(Mar. 1961). (In Russian)

X-ray diffraction and etching analyses were made of neutron radioinduced defects in LiF and α-quartz crystals and of deformations in LiF and Al crystals. A certain regularity was observed. (tr-auth)

17372 RADIOACTIVITY AND THE PHYSICOCHEMICAL PROPERTIES OF A MATERIAL. L. M. Kopytin and Yu. V. Gagarinskii. Atomnaya Energ., 10: 238-43(Mar. 1961). (In Russian)

Certain properties of radioactive materials result from self-irradiation. Systems containing radioactive elements are in a nonequilibrium state. The fraction of particles (molecules, atoms, and ions) possessing higher energies exceeds the equilibrium. The areas of α and β particle decay and the areas of atom recoil have an increased concentration of structural defects and an increased free energy. These factors influence the vapor pressure, solubility, dissociation pressure, equilibrium constant in chemical reactions, reactivity, heat capacity, density, electric conductivity, thermal conductivity, and other properties as well as phase transformation. (tr-auth)

17373 ASSOCIATED PROCESSES TO THE SZILARD-CHALMERS EFFECT IN CRYSTALS. I. HEXAMMINO-COBALTIC NITRATE. T. Costea (Inst. of Atomic Physics, Bucharest). J. Inorg. & Nuclear Chem., 17: 20-5(Apr. 1961). (In English)

The annealing processes associated to the Szilard-Chalmers effect were studied. By analogy with annealing following neutron irradiation, annealing concomitant to irradiation in a reactor may be taken into account. The annealing is described by means of the retention. It was observed that the retention increases with time until it reaches a saturation value R_∞, characteristic for a certain γ-dose-rate. This behaviour is rather difficult to interpret. There exists a great similarity between the obtained curves and the results usually found by heating the irradiated samples. (auth)

17374 PHOTO-ANNEALING OF (n,γ) EFFECTS IN BROMATES. L. Arizmendi and A. G. Maddock (University Chemical Labs., Cambridge, Eng.). J. Inorg. & Nuclear Chem., 17: 191(Apr. 1961). (In English)

Results obtained from illuminating neutron irradiated anhydrous calcium bromate with light from a Hanovia UVS 250 lamp are graphically presented. The results show that a sheet of paper interposed between the lamp and the powdered crystals gives a retention, R, substantially the same as the unilluminated material. The macrocrystalline material gives a limited change which may reflect a high absorption coefficient for the incident light. However, in the powdered samples an effectively larger volume of calcium bromate lies within a given distance from the surface of the crystals. (N.W.R.)

17375 E.S.R. OF IRRADIATED DPPH PROTECTED BY POLYSTYRENE. Kohzoh Masuda and Tokuo Suita (Osaka Univ.). J. Phys. Soc. Japan, 16: 837-8(Apr. 1961). (In English)

The number of electrons in diphenylpicryl hydrazl with polystyrene under γ-irradiation was studied. It is shown from comparison of experimental and theoretical data that there is not only a shielding effect of polystyrene but also a protection mechanism. The results are observed from graphical data of the annihilation and production coefficients of unpaired electrons in polystrene. (N.W.R.)

17376 EFFECT OF REACTOR RADIATION OF ORGANIC MATERIALS. SAFETY CONSIDERATIONS BEFORE CARRYING OUT THE IRRADIATION. W. Schilling (Technische Hochschule, Munich). Kerntechnik, 3: 106-10(Mar. 1961). (In German)

As the last point before investigation of the effect of reactor radiation on the sample, the physical principles of the radiation damage of the organic material, above all of high polymer plastics, should be sketched. Then the dangers, which can arise in the reactor operation in the irradiation of a sample, should be shown. This is chiefly connected with the reactivity changes in the sample and with the corrosion or solution of the active sample with a possible destruction of the covering during the irradiation. (tr-auth)

17377 EFFECTS OF NUCLEAR RADIATION ON RUBBER. John W. Born (B. F. Goodrich Co., Research Center, Brecksville, Ohio). Materials Research & Standards, 1: No. 4, 280-6(Apr. 1961).

The effects of nuclear radiation on rubber is discussed. It shows how radiation effects can be used to advantage, radiation damage may be defined in terms of stress-strain and dynamic mechanical properties, and how detrimental effects in rubber polymers and products may be partially inhibited. (N.W.R.)

17378 PRECIPITATION OF LITHIUM IN LITHIUM FLUORIDE SINGLE CRYSTALS BY IRRADIATION WITH THERMAL NEUTRONS. M. Lambert, Ch. Mazieres, and A. Guinier (Faculté des Sciences, Orsay, France and Conservatoire National des Arts et Metiers, Paris). Phys. and Chem. Solids, 18: 129-38(Feb. 1961). (In French)

Earlier x-ray-diffraction results have shown that Li precipitation occurs in LiF by radiation damage. Thin plates of atomic thickness are produced and for larger neutron doses, anomalous f.c.c. Li appears in epitaxy on the LiF lattice. By heating, this Li is transformed into normal, b.c.c. Li. These results are in good agreement with those found by a fundamentally different method, the differential thermal micro-analysis (μD.T.A.), and by means of the two methods (x-ray-diffraction and μD.T.A.), the transformations of Li inclusions on heating were studied. (auth)

17379 NEUTRON IRRADIATION OF Cu–Al AT ELEVATED TEMPERATURES. R. H. Kernohan and M. S. Wechsler (Oak Ridge National Lab., Tenn.). Phys. and Chem. Solids, 18: 175-80(Feb. 1961). (In English)

The effect of neutron irradiation at elevated temperatures on the electrical resistivity of Cu–Al (15 at. % Al) is described. The results support the idea that at temperatures below 200°C the alloy is in a metastable state. Upon irradiation atomic mobilities are enhanced and the metastability is eliminated, accompanied by a decrease in resistivity. An analysis is made of the temperature dependence of the rate of the atomic rearrangement stimulated by the irradiation. It is found that the activation energy for motion remains constant during the process at about 0.5 ev. A comparison

is made with the results of a previous experiment in which the alloy was irradiated at lower temperatures. (auth)

17380 TEMPERATURE DEPENDENCE OF ELECTRON-BOMBARDMENT-INDUCED CONDUCTIVITY IN MgO. [PART] II. William C. Schieve and Martin A. Pomerantz (Bartol Research Foundation, Swarthmore, Penna.). Phys. Rev., 122: 808-14(May 1, 1961).

Previous measurements of the temperature dependence of the electrical conductivity induced in single crystals of MgO by bombardment with 1.3-Mev electrons over the temperature range 290°K to 600°K are extended to 100°K. The bombardment-induced current, I_c, varies linearly with primary current, I_p, at 298°K and at 105°K. However, in certain cases measurements of I_c vs. applied voltage, V_c, reveal a deviation from Ohmic behavior which is enhanced at low temperature. The bombardment-induced conductivity exhibits a maximum near 250°K. Both crystals display a temperature dependence at low temperatures which is consistent with the power-law relationship $I_c/I_p = kT^m$, where m = 3.3 and 3.8, respectively. A rising non-Ohmic I_c vs. V_c characteristic appears to be dependent upon the magnitude of the applied field, the onset occurring at 3×10^4 v/cm. Collision ionization and warm carrier phenomena, rather than surface effects, probably account for the observed results. It is impossible to ascribe the temperature dependence of the bombardment-induced conductivity solely to the temperature variation of the carrier mobility. The results can be explained in terms of change with temperature of both the lifetime and mobility of the charge carriers. A combination of optical mode (polaron), acoustical mode, and ionized impurity scattering is assumed, in addition to a temperature-dependent capture cross section for the carrier. The theoretical curve fits the experimental data satisfactorily, and gives reasonable values for the parameters. (auth)

17381 CONCERNING THE ORDER OF RADIATION STABILITY OF SOLID NITRATES. A. S. Baberkin (Karpov Inst. of Physics and Chemistry). Zhur. Fiz. Khim., 35: 373-5(Feb. 1961). (In Russian)

The effect of various factors (number of electrons in the outer shell of the cation, size of the free volume of the elementary cell, etc.) on the order of stability of nitrates toward the action of γ rays was investigated. The order of stability for nitrates with cations of the second group of the periodic system is similar to that for the change in free volumes of the elementary cells of crystals. The radiation stability of nitrates with cations possessing an 18 electron outer layer is somewhat less than for nitrates with cations of comparable size, but with an 8 electron shell. (tr-auth)

PHYSICS

General and Miscellaneous

17382 (AE-52) THERMO-TECHNICAL DATA FOR D_2O, TABLE 2A1. Einar Axblom (Aktiebolaget Atomenergi, Stockholm). Mar. 1961. 15p.

A summary of the measurements on the saturated volumes of D_2O liquid and steam is presented for the range 4 to 300°C. A formula for extrapolation of these values from 300 to 370°C is included. (J.R.D.)

17383 (AFOSR-508) ON A POSSIBLE ENHANCEMENT OF RELATIVISTIC INCREASE IN IONIZATION. Scientific Note No. 2. P. Budini, L. Taffara, and C. Viola (Trieste. Università. Istituto di Fisica). Dec. 15, 1960. Contract AF61(052)-211. 12p.

The possibility that a relativistic increase of primary ionization could be augmented by the contribution of ions due to reabsorption of Cherenkov radiation is discussed. A method was developed to determine this possibility in mixtures of elements with different ionization potentials. The general formulas of the effect are given and discussed, and applied to mixtures of H + He and He + alcohol. (auth)

17384 (AFOSR-549) RARE EARTH OXIDE SYSTEMS. PART I. A COMPARISON OF THE HYSTERESIS EFFECTS IN PRASEODYMIUM OXIDE AND EVERETT'S THEORY OF HYSTERESIS. Paul A. Faeth and Alan F. Clifford (Purdue Univ., Lafayette, Ind.). Mar. 17, 1961. Contract AF 18 (603)-45. 20p.

The composition-pressure diagram of the Pr–O system was studied at 10^{-5} to 150 mm oxygen pressure using a quartz beam microbalance. The isotherms between 400 and 500°C show hysteresis between $PrO_{1.80}$ and $PrO_{1.83}$ as the pressure varies. At 465°C a hysteresis loop extends over the entire pressure range. Everett's theory of hysteresis is compared with the Pr–O isotherms at 465°C. The seven theorems proposed by Everett are cited and discussed with reference to the Pr–O data. In general the agreement between the properties of Everett's theoretical model of a domain system and the properties of the Pr–O system is good. The behavior of the praseodymium oxide system is thought to be a result of its being composed of domains of various stable compositions such as $PrO_{1.83}$, $PrO_{1.80}$, and others. The domains change composition as a function of the oxygen pressure. (auth)

17385 (AWRE-O-65/60) GAMMA RAY CROSS-SECTIONS AND SCATTER LAWS FOR USE IN TRANSMISSION CALCULATIONS. B. R. S. Buckingham and E. D. Pendlebury (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Apr. 1961. 27p.

Gamma-ray cross sections and scatter laws for use in transmission calculations were written on punched cards suitable for use on IBM 704, 709, or 7090 machines. Cross-section graphs are presented for H, C, N, O, Al, Fe, Pb, U, and Pu and for the angular distributions from Compton scattering in the energy range 0.01 to 20 Mev. (D.L.C.)

17386 (EOS-150-M-10) INVESTIGATION OF IONIZED GASES IN CONNECTION WITH GUIDED MISSILE PROBLEMS. Monthly Progress Report for January 1959. S. Naiditch (Electro-Optical Systems, Inc., Pasadena, Calif.). Jan. 10, 1959. Contract DA-04-495-1191. 9p.

Modifications of the collimating and accelerating electrodes and insulators and design of the calorimetric system were continued. A general review and analysis was made for the purpose of both evaluating the capabilities and limitations of the present experimental arrangement for studying surface ion sources. Instruments were modified to decrease the effects of line transients. A new transformer service was installed. New collimator and accelerating grid electrodes were fabricated to eliminate sharp edges where high voltage breakdown might occur. The limits of error and limitations of several types of optical pyrometers were investigated and the desirability of using a two-color pyrometer was indicated. (M.C.G.)

17387 (GEAP-3283) CALCULATION OF THE MAXIMUM EFFICIENCY OF THE THERMIONIC CONVERTER. John H. Ingold (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Dec. 1959. 15p. (R59APE38)

An analysis of the efficiency of a thermionic converter was made in terms of the potential difference V_a between the top of the potential barrier in the interelectrode space and the Fermi level of the anode, the potential drop, V_L, across a load impedance in series with the converter, and the potential drop, V_i, in the necessary electrical connection to the cathode. It was concluded that low value of V_a is required for high efficiency and relatively low values of V_c are required for maximum efficiency at ordinary cathode temperatures. A guide was prepared which gives the optimum values of the appropriate parameters required for maximum efficiency. (auth)

17388 (IS-266) SEEBECK EFFECT IN MAGNESIUM SILICIDE. Marvin William Heller and G. C. Danielson (Ames Lab., Ames, Iowa). Nov. 1960. Contract W-7405-Eng-82. 113p.

The Seebeck coefficient (thermoelectric power) was measured from 7 to 1000°K for both n-type and p-type single crystals of Mg_2Si. The room temperature carrier concentrations were as low as 3×10^{16} cm^{-3} for n-type samples and about 2×10^{18} cm^{-3} for the silver-doped, p-type samples. At low temperatures, the magnitude of the Seebeck coefficient showed a pronounced maximum which is interpreted in terms of the phonon drag effect. The phonon contribution, S_p, was obtained from the measured Seebeck coefficient by subtracting off the electron diffusion term, S_e, which was calculated with the aid of the measured Hall coefficient. The magnitude of S_p was observed to be proportional T^{-3} and to show the dependence on sample size and on carrier concentration predicted by the theory of C. Herring. At temperatures above 200°K, S_p was small compared to S_e. In the intrinsic temperature range (650 to 1000°K), the Seebeck coefficients of the n-type samples were proportional to 1/T and implied a mobility ratio of about 3.5. Mass parameters of $m_n \cong 0.4\ m_0$ and $m_p \cong 2\ m_0$ were found to be consistent with the extrinsic Seebeck data as well as the intrinsic Hall and Seebeck data if optical-mode scattering predominated in the purer n-type samples and optical-mode scattering was comparable with ionized impurity scattering for the p-type samples at 300°K. (auth)

17389 (NP-10122) ANNUAL REPORT [FOR] 1959. (Gt. Brit. Low Temperature Research Station. Radiation Group, Cambridge, England). 39p.

Work concerned with the causes and prevention of deterioration of food is reported. Included in the investigation were: the causes and effects of stress in animals immediately before slaughter, advantages of irradiating pork and beef in frozen state for sterilization, flavor deterioration

in oxidized fats, texture of poultry meat, poultry plant hygiene, strength of the egg, and discoloration in potatoes. (M.C.G.)

17390 (PR-P-48) PHYSICS DIVISION PROGRESS REPORT FOR OCTOBER 1, 1960–DECEMBER 31, 1960. (Atomic Energy of Canada Ltd., Chalk River Project, Chalk River, Ont.). 80p. (AECL-1196)

A preliminary attempt was made to detect the J = 6 + level in Mg^{24} by the reaction $Na^{23}(p,\gamma)Mg^{24}$. No γ rays of the energy expected were observed. The reaction $F^{19}(\alpha,p\gamma\gamma)$ was studied. Alpha energies for making the γ-γ correlation measurements for 2 or 3 excited states were determined. The γ yields from the ground and first excited states of Mg^{24} were measured separately. Measurements were made of γ rays from the reaction $H^3(p,\gamma)He^4$ for proton energies between 5.0 and 9.4 Mev. No sign of the structure observed by Milone was found. A beam collimator and slits to limit the particle trajectories were built and assembled on the 65-cm spectrograph. It was found that the reaction of C^{12} with other nuclei showed a large emission probability comparable to that of α particles. The reaction $Si^{28}(\alpha,p\gamma)P^{31}$ was studied using a small junction counter to measure the protons at 0°. The reaction $(\alpha,n\gamma)$ was studied using targets of O^{18}, Si^{30}, S^{34}, Be^9, F^{19}, and Mg^{26}. The cosmic neutron intensity at Deep River was observed to double or more during the flares of November 12 and 15. The shape of the increase was recorded and the chain of events causing it deduced. The internal conversion electron spectrum in Dy^{161} following β decay from Tb^{161} was studied. The main features of the disintegration scheme of Nd^{146} were established. Conversion line studies of Ba^{140} decay were extended. The validity of the Ce^{144} decay scheme deduced from conversion line studies was confirmed. Preliminary experiments were carried out to assess the feasibility of precise γ-energy measurements using the external conversion process. The half life of Br^{82} was measured to be 35.34 ± 0.02 hr. Experimental determination of the dispersion curves for lattice vibration in sodium were continued. Measurements of the total cross section of a single crystal of quartz in 2 undetermined orientations were made for neutrons with energies from 0.037 to 0.16 ev. Measurements were made of neutrons scattered from a thin film of water. Time-of-flight distributions of neutrons scattered from liquid helium were observed for both rotating and stationary conditions of the liquid. The circular polarization of γ rays following the capture of polarized neutrons by various nuclei was measured. An advanced control system for the twin spectrometer experiment in NKV was completed. The CIR reactor control system was further tested. A detailed component-fault record was compiled covering the past 2 years. Other electronic equipment development is reported. Xenon instability of reactors, shimming of magnets, octupole vibration of spherical nuclei, quadrupole interactions in nuclei, resolution corrections for energy distributions of thermal neutrons, diffusion of oxygen in zirconium, and the redistribution of hydrogen in Zircaloy are discussed. (M.C.G.)

17391 (SCR-296) A TECHNIQUE FOR OBTAINING PARTICLE ACTIVITY AND SIZE DISTRIBUTIONS. M. Cowan, Jr. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 12p.

Presented at Rochester Aerosol Meeting, Rochester, New York, October 1960.

An autoradiographic technique is described for determination of the frequency distribution of particles by the amount of radioactivity per particle. When the active particles are wholly composed of some radioactive element or its oxide, a particle size distribution also results, provided some assumption regarding particle shape is possible. Autoradiographs are obtained for several different exposure times from a geometry which, discounting self-absorption, makes particle signatures visible after exposure times which are inversely proportional to particle activity. Corrections can be applied for self-absorption. One radiochemical analysis is necessary to determine the mean amount of activity per particle. The method was tried only on plutonium-bearing particles; however, similar methods may be applied for analysis of other kinds of radioactive dusts. (auth)

17392 (TID-12141) RESEARCH INTO THE DIFFUSION OF INERT GASES IN SOLID BODIES. Quarterly Report No. 1, July 1 to September 30, 1960. (Hahn-Meitner-Institut für Kernforschung, Berlin). Oct. 26, 1960. Contract EUR/C/710/2/60d. 11p. AEC 66/Euratom 114

Work was begun on the construction of an apparatus for measuring the total activity of the fission inert gases contained in uranium compounds. Apparatus for continuous measurement of Ar^{41} diffusion in potassium salts and of Xe^{133} diffusion in uranium oxides and for discontinuous measurements of Xe^{133} and Kr^{85} diffusion in uranium carbide are described. It was found that organic potassium salts are unsuitable for the diffusion measurements. The materials necessary were obtained. Preliminary tests on the apparatus were completed. (M.C.G.)

17393 (TID-12299) PROPAGATION OF ELASTIC WAVES IN THIN PLATES. PART II. AN ANALYTICAL STUDY OF ELASTIC WAVES USING APPROXIMATE EQUATIONS OF MOTION. Billy C. Ellis (Texas. Univ., Austin. Structural Mechanics Research Lab.). Aug. 1960. 55p. For Sandia Corp. Contract AT(29-2)-621. (SCDC-2244)

A problem of symmetrical stress waves propagating in a thin plate with a small circular hole at the center is solved by the method of characteristics. Initial conditions considered are uniform radial stress applied at the boundary of the hole as a step function of time; a uniform radial stress applied at the boundary of the hole as a rectangular pulse; a uniform radial stress applied at the boundary of the hole as a half sine wave; and a uniform particle velocity applied at the boundary of the hole as a single cycle, sinusoidal function of time. The results obtained for the first condition are compared with earlier results obtained by using Laplace transform theory. The two methods of solution give identical results. From this, it is concluded that the accuracy of the method of characteristics is adequate for investigating problems in which other types of initial conditions are involved. It is found that the decay of stress, strain, and particle velocity with distance from the boundary of the hole, depends significantly upon the nature of the initial conditions. (auth)

17394 (TID-12431) SURFACE BOMBARDMENT STUDIES. Report No. 2163. Annual Report - 1960, February 15, 1960 to February 14, 1961. G. K. Wehner, G. S. Anderson, N. Laegreid, and D. Rosenberg (General Mills, Inc. Mechanical Div., Minneapolis). Mar. 1, 1961. Contract AT(11-1)-722. 104p.

Experimental studies were made of atom ejection patterns in single crystal sputtering. Previous work in Hg was extended to other materials (Mo, V, W, Ti, α brass, etc.), to other gases (Ne and Ar), and to other higher order crystal planes. It was found that physical sputtering below 1-kev ion energy is more a surface and near-surface phenomenon than previously thought and focusing chains longer than a few atoms spacing are probably not involved. Patterns

from bcc crystals of different materials revealed a fine structure characteristic of each material; this result is not as yet completely understood. Studies in different noble gases revealed that interstitials formed when Ge or Si surfaces are bombarded with ions must be Ge or Si interstitials, implying that Ge or Si lattices near the surface are converted under bombardment from diamond lattice structure to a more bcc structure. Sputtering yield measurements are discussed. In He sputtering, yield curves were determined for about 25 metals in the energy range up to 600 ev. Yields were found to be rather low (less than ~0.2 atoms/ion) and results showed the same consistent rise in yields with degree of filling of d-shells, as previously found for Hg, Ar, Ne, and Xe bombardment. In Hg sputtering, yields of various materials were measured with a beam hole drilling method in the 4 to 15 kev energy range. Yields as a function of the target atomic number showed the same periodic dependence as observed at low ion energies. (auth)

17395 (TID-12497) DETONATION PERFORMANCE CALCULATIONS USING THE KISTIAKOWSKY-WILSON EQUATION OF STATE. Charles Mader (Los Alamos Scientific Lab., N. Mex.). [1960?]. 22p.

The Kistiakowsky-Wilson equation of state as modified by Cowan and Fickett was used to estimate the detonation performance of explosives composed of various combinations of the elements carbon, hydrogen, nitrogen, boron, aluminum, oxygen, and fluorine. The computed velocities, pressures, and temperatures are compared with the available experimental detonation velocities, Chapman-Jouguet pressures and brightness temperatures. Over a wide range of density and composition, the computed and experimental pressures and temperatures agree to within 20%, the detonation velocities to within 10%. The interrelationships between temperature, pressure, and the particle density of the C-J products as predicted by the Kistiakowsky-Wilson equation of state are discussed. (auth)

17396 (TID-12579) THE CESIUM-137 POWER PROGRAM. Quarterly Progress Report No. I. (Royal Research Corp., Hayward, Calif.). Apr. 1961. Contract AT(04-3)-366. 80p. (RRC-CS-0100)

The preparation of a chemical form of cesium with high cesium content, insolubility in aqueous media, and other desirable characteristics for use as generator fuel material was investigated. The materials studied included cesium silico-tungstate, cesium-enriched kaolin clay, cesium-enriched kaolin sand, and cesium-enriched complex borosilicates. It was found that the silica content determined the resistivity of the product to leaching, if the ingredients were homogeneously mixed before fusion. The hot-cell application of the procedures for cesium form fabrication is discussed. Solubility data for water are presented for cesium forms containing high silica additions, slight borosilicate additions, and trace borosilicate additions. In heat transfer studies, the thermal conductivity of Fiberglas under evacuation was measured. Data are presented for the efficiency of a Westinghouse thermoelectric couple as a function of cold junction temperature. The outer skin thicknesses for a generator in the shape of a right circular cylinder which are required to resist the crushing pressure at 2- and 5-mile ocean depths are calculated. (D.L.C.)

17397 (UCRL-6244) A NEW EXPLOSIVE COMPATIBILITY TEST. Jack W. Frazer (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1960. Contract W-7405-Eng-48. 23p.

A new explosive compatibility test is described. The explosive system to be tested is heated for a predetermined time. At the end of this heating period the volatile solvents and decomposition products are analyzed. The analysis is accomplished by three chromatography columns, which are operated in series or parallel as needed. The data thus obtained are far more valuable than those obtained from one-parameter tests such as vacuum stability. (auth)

17398 (UCRL-9203) AN ANALYSIS OF THE ABSORPTION SPECTRA OF Tm(IV) AND Am(IV). (thesis). John Balsbaugh Gruber (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1961. Contract W-7405-eng-48. 153p.

An analysis of the absorption spectra of $Tm(C_2H_5SO_4)_3 \cdot 9H_2O$ and AmIV in $LaCl_3$ is presented. For TmIV, all levels corresponding to $4f \rightarrow 4f$ transitions except transitions from $^3H_6$ to $^1S_0$ were observed and fitted to a theoretical model which gives $\zeta_{4f} = 1350\ cm^{-1}$, and $F_2(4f) = 450\ cm^{-1}$. The 119 electronic energy levels for the nf^6 configuration were calculated for three different sets of Slater F_k ratios: $4f^6$ hydrogenic—$F_4/F_2 = 0.1381$, $F_6/F_2 = 0.01511$; $5f^6$ hydrogenic—$F_4/F_2 = 0.1422$, $F_6/F_2 = 0.0161$; and $5f^6$ based on a Hartree-Fock calculation—$F_4/F_2 = 0.159$, $F_6/F_2 = 0.0204$. A tentative theoretical analysis of the absorption spectra of Eu IV can be made by using $\zeta = 1360\ cm^{-1}$ and $F_2(4f) = 370\ cm^{-1}$. It was possible to carry out a crystal-field splitting analysis of all the infrared electronic energy levels of AmIV. Parameters that fit the observed data are $A_2^0\langle r^2\rangle = 206\ cm^{-1}$, $A_4^0\langle r^4\rangle = -94.1\ cm^{-1}$, $A_6^0\langle r^6\rangle = -93.8\ cm^{-1}$, and $A_6^6\langle r^6\rangle = 1100\ cm^{-1}$. (auth)

17399 (USASRDL-TR-2162) A NEW RADIATION-RESISTANT HIGH-EFFICIENCY SOLAR CELL. G. Mandelkorn, C. McAfee, J. Kesperis, L. Schwartz, and W. Pharo (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Oct. 1960. 10p. (AD-247184)

Details of a phosphorus-diffusion process for fabrication of high-efficiency silicon solar cells are presented. The phosphorus-diffused cells have high efficiencies, and a radiation resistance that is superior to commercial cells by at least an order of magnitude. Data on the electrical characteristics and radiation resistance of the cells are analyzed, and possible application of the new cells to satellites and atomic-powered batteries is considered. (auth)

17400 (AEC-tr-4555) FACTORS INFLUENCING THE EMANATING POWER OF ARTIFICIAL SALTS AND MINERALS DEPENDENCE OF THE EMANATING POWER OF ARTIFICIAL SALTS AND MINERALS ON PARTICLE SIZE FOR RADON, THORON, AND ACTINON. I. E. Starik and O. S. Melikova. Translated from Radiokhimiya, 1: 196-203(1959). 8p.

An investigation was made of the factors influencing the radioactivity of prepared salts containing Ra, Th, and Ac. The radioisotopes were introduced into salts of palmitic and stearic acid in the preparation of long-lived standards using cerium as the carrier. Temperature within the range of −10 to 40°C did not exert any influence on the emanating power, but at −15° it was reduced by 15%. The emanating power of the crystals was found to be but slightly dependent on changes in the specific surface area. The increase was variable as a function of the degree of pulverization and was dependent on the preservation of the specimen. (M.C.G.)

17401 THE COUPLING BETWEEN ELECTRONIC AND NUCLEAR MOTION AND THE RELATIVISTIC EFFECTS IN THE GROUND STATE OF THE H_2 MOLECULE. W. Kolos and L. Wolniewicz (Inst. of Physical Chemistry, Polish Academy of Sciences, Warsaw and N. Copernicus Univ.,

Toruń, Poland). Acta Phys. Polon., 20: 129-40(1961). (In English)

The contribution to the binding energy of the hydrogen molecule by the coupling between nuclear and electronic motion is calculated. The wave function employed was in the form of an expansion in elliptic coordinates. The most reliable result obtained with a four term expansion is $\Delta D' = -5.1\ cm^{-1}$. The relativistic corrections calculated with a five term expansion change the binding energy by $\Delta D = -2.4 - E_2\ cm^{-1}$, where E_2, the classical relativistic correction to the interaction between the electrons, is of the order of $-1\ cm^{-1}$ or smaller. The calculated corrections added to the accurate nonrelativistic result for infinitely heavy nuclei give the theoretical binding energy D = 38280 cm^{-1}, the experimental value being D = 38286 ± 6 cm^{-1}. (auth)

17402 GAS MIXING PROCESSES IN ALTERNATING CURRENT GLOW DISCHARGE. H. Deutsch (Ernst-Moritz-Arndt-Universität, Greifswald, Ger.). Ann. Physik (7), 6: 355-60(1960). (In German)

The mixing occurring in a gas mixture as a result of the passage of an alternating current was investigated in dependence on the frequency of the discharge current (50 and 400 Hz and 540 kHz), the dimensions of the discharge tube, the current intensity, total gas pressure, the partial pressure of the gas added, and the type of gas. (tr-auth)

17403 THE EXPANSION OF THE STATISTICAL ATOMIC MODEL WITH THE CORRELATION FUNCTION. P. Gombás (Polytechnic Univ., Budapest). Ann. Physik (7), 7: 1-7(1961). (In German)

An approximate expression for the correlation energy of an electron gas was stated by Lewis for the expansion of the Thomas-Fermi-Dirac equation. The expression in the case of very high electron densities changes into the exact expression derived by Gell-Mann and Brueckner. In the present work it was shown how the expansion of the Thomas-Fermi-Dirac equation can be traced back, by simplification of the Lewis expression, to the case treated previously by the author (Z. Physik 121, 523(1943)). The correlation energy was represented by an expression derived by Wigner. The solution of the expanded equation is given for several atoms and ions. Calculations were made for the correlation energy of the Xe atom. (tr-auth)

17404 THE HYPERFINE STRUCTURE OF EUROPIUM. [PART] I. K. Krebs and R. Winkler (Technische Universität, Berlin-Charlottenburg, Ger.). Ann. Physik (7), 7: 77-83 (1961). (In German)

For the europium isotopes 151 and 153, hyperfine structure anomalies were established, that is, the ratios of the splitting factors to excited terms and to the ground states were found to be different. "Exchange polarization" was suggested as the origin of the splitting of the ground state. (tr-auth)

17405 LAMINAR STAGNATION FLOW OF AN ELECTRICALLY CONDUCTING FLUID AGAINST AN INFINITE PLATE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. A. S. Gupta (Indian Inst. of Tech., Kharagpur). Appl. Sci. Research, B, 9: 45-50(1961). (In English)

The two-dimensional stagnation flow of an electrically conducting, incompressible, and viscous fluid against a plane wall is investigated for the case when the induced field is negligible compared to the imposed transverse magnetic field. It is found that the component of the velocity parallel to the plate as well as the drag coefficient decrease with the increase in the magnetic field. Furthermore, it is observed that the velocity component parallel to the plate is essentially constant except in a layer of constant thickness, a result which is true in the non-magnetic case also. (auth)

17406 COMPLEX CONDUCTIVITY OF SOME PLASMAS AND SEMICONDUCTORS. P. H. Fang (National Bureau of Standards, Washington, D. C.). Appl. Sci. Research, B, 9: 51-64(1961). (In English)

The complex conductivities of plasmas and semiconductors are calculated for several cases where the collision frequency can be expressed as a power function of the energy. From the result, some characteristic parameters of the plasma originally investigated by Spitzer are estimated. The problem of determining the relaxation time from a non-symmetrical dispersion is discussed. (auth)

17407 ELECTROMAGNETIC GENERATION OF VORTICITY IN THE UNIFORM EFFLUX OF A CONDUCTING FLUID FROM THE SURFACE OF A MAGNETIZED SPHERE. J. D. Murray (University Coll., London). Appl. Sci. Research, B, 9: 65-76(1961). (In English)

The electromagnetic forces in the flow of an electrically conducting fluid in the presence of a magnetic field are nonconservative and therefore produce vorticity. The simple case of uniform efflux of a conducting fluid from the surface of a magnetized sphere is studied. Two methods are developed: one gives the solution for small conductivity and any magnetic intensity, the other gives the solution for small magnetic intensity and any conductivity. The case evaluated in detail is that for a magnetic dipole situated at the center of the sphere. The magnetic lines, streamlines, and vortex lines are found in closed form and are shown for two values of the parameters involved. (auth)

17408 ISENTROPIC ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC CHANNEL FLOW. Boris Podolsky (Univ. of Cincinnati) and A. Sherman. Appl. Sci. Research, B, 9: 77-84(1961). (In English)

It is usual in the analysis of one-dimensional channel flows to study the behavior of the analogous isentropic flow since, first, it retains the essential features of flows of practical interest and, secondly, it is simpler to describe. Although in conventional channel flows it is sufficient to neglect heat addition and friction to ensure isentropicity, in the MHD case it is in addition necessary to neglect Joule heating. This is accomplished by considering the fluid as having infinite electrical conductivity. However, this procedure does not necessarily imply infinite currents, since the external resistance will limit current flow. In the conventional problem, if an isentropic flow is assumed, a once integrated form of the governing equations may be obtained. Such once integrated solutions are not possible in the present isentropic MHD channel flow, but equally simple solutions can be found and are presented. Examples of application of these results to the crossed field MHD generator and accelerator are also given. (auth)

17409 PHYSICAL REPRESENTATION OF ELEMENT SYSTEMATICS. Constantin Bedreag (Univ. of Iasi). Compt. rend., 252: 1604-6(Mar. 13, 1961). (In French)

Modifications to the periodic table, which take into consideration the nature of the rare earths, the uranides, and curinides, are given. The advantages offered by this representation are discussed. (J.S.R.)

17410 A CONTRIBUTION TO THE THEORY OF IMPACT EXCITATION BY EXPLOSIONS. G. T. Afanasev, V. K. Bobolev, and L. G. Bolkhovitinov (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 642-3(Jan. 21, 1961). (In Russian)

The excitation of explosion in solids as a result of plastic deformation and chemical reaction created by shock is

analyzed. It is postulated that plastic deformation plays the major role in producing temperatures and that the intensity of the heat emission depends on the plastic properties of the substance and on the loading conditions. (R.V.J.)

17411 STEADY FLOW OF CONDUCTING VISCOUS INCOMPRESSIBLE FLUID IN TUBES IN UNIFORM AND NON-UNIFORM MAGNETIC FIELD. A. E. Yakubenko. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr, No. 1, 90-5(Jan.-Feb. 1961). (In Russian)

A series of problems on steady conducting flow in pipes under transverse magnetic fields are analyzed with the assumption that all magnitudes, except for pressure, do not alter the flow direction. Such general aspects of the problem lead to the integration of two linear second-order equations in the quotient derivatives at given limiting conditions. (R.V.J.)

17412 A SIMPLE UNIFIED FIELD EQUATION AND HYPOTHESIS. A. T. Gresky (Oak Ridge National Lab., Tenn.). J. Franklin Inst., 269: 105-24(Feb. 1960).

A unified field equation of force, that is, $F_u = m_e^2c^3/\hbar\alpha_e^2 = m_e^2c^4\epsilon_0/e^2\alpha_e = 0.5m_e^3c^5/E_R\hbar = \hbar cS_e^2/M_\beta^2m_e^2 = \hbar c/L_m^2 = mr_o^3\omega_o^2\omega_e^2/r_e^2B_a^2 = mr_e\omega_e^3\omega_n^3/\omega_p^2B_a^2 = G/\mu_b^2 = 1.23163 \times 10^{23}$ g cm/sec^4 gauss^2 $= 3.981 \times 10^8$ dynes is developed from well-known physical quantities such as electronic mass (m_e); the light velocity constant (c); the angular momentum constant ($\hbar = h/2\pi$); the electronic fine structure constant (α_e); the dielectric constant ($\epsilon_0 = 1.0$); the electronic charge (e); the Rydberg energy (E_R); electronic spin ($\hbar/2$); the Bohr magneton (M_β); the electron's "classical radius" (L_m); the Earth's mass (m); the moon's average orbital radius (r_o) and angular velocity (ω_o); the rotating Earth's angular velocity (ω_e), radius (r_e), polar magnetic intensity (B_a), angular velocity of nutation (ω_n), angular velocity of precession (ω_p); the gravitation constant (G); and a proposed proportionality constant of terrestrial and stellar magnetism ($\mu_b = r_eB_a/m\omega_e = 7.359 \times 10^{-16}$ cm sec gauss/g $= 1.2943 \times 10^{-9}$ cm/g, where one gauss unit is considered equal to 1.7589×10^7/sec). The fact that $\hbar c\mu_b^2/GL_m^2$ is equal to 1.000 suggests that μ_b and L_m are, respectively, universal constants of macroscopic and submicroscopic particle magnetism, and that the equation F_u prescribes a single universal physical law governing the action-reaction of all particles and fields, whether astronomic or submicroscopic in character. (auth)

17413 ON THE THEORY OF ADIABATIC AND ISOLATED SUSCEPTIBILITIES. Nobuhiko Saito (Univ. of Oregon, Eugene). J. Phys. Soc. Japan, 16: 621-6(Apr. 1961). (In English)

A quantum statistical mechanical proof of the equivalence of adiabatic and isolated susceptibilities in large systems is given by Broer's method using a Gibbs relation. Further a brief mention is made of the susceptibilities in non-equilibrium cases. (auth)

17414 ENTROPY PRODUCTION AND VARIATION PRINCIPLE IN THE KINETIC THEORY OF RIGID-SPHERE GAS MIXTURE. Terutosi Murakami (Kyushu Univ., Fukuoka, Japan). J. Phys. Soc. Japan, 16: 633-54(Apr. 1961). (In English)

The balance equations and the fluxes of thermodynamic variables are obtained on the basis of the modified Boltzmann equation for a multicomponent rigid-sphere gas. The kinetic expression of entropy balance is obtained in terms of the H-theorem, the correction to the entropy due to imperfectness of the gas being added. The correction is calculated from the equation of state, which is derived from the momentum transport equation. The entropy balance is also formulated thermodynamically with the aid of the Gibbs relation. By the use of these two expressions a variational problem concerning the entropy production rate can be set up. The solution of this problem leads to the first approximation equation for singlet distribution function, which is identical with Enskog's one apart from the terms independent of the energy dissipation. (auth)

17415 SORPTION OF RADON ON POLISH CHARCOALS. Roza Przytycka (Inst. of Nuclear Research, Academy of Sciences, Warsaw). Nukleonika, 6: 23-32(Jan. 1961). (In Polish)

Eight polish charcoals were investigated for their sorption qualities for radon. The quantities of radon, which were adsorbed were about 10^{-9} to $^{-8}$ curie. The adsorption was carried on in dynamic conditions in a closed cycle. There were chosen 3 kinds of charcoals of a high adsorption coefficient of about 5000. These are the active coal and the coal "A" from Hajnówka, and the coal "Carbopol Z-3" from Racibórz. (auth)

17416 ON THE CALCULATION OF RADIAL WAVE FUNCTIONS CORRESPONDING TO ENERGIES IN THE CONTINUUM PART OF THE HELIUM SPECTRUM. C. C. Grosjean and R. T. Van de Walle (Rijksuniversiteit, Ghent). Nuovo cimento (10), 19: 696-722(Feb. 16, 1961). (In English)

For the purpose of recalculating the He primary specific ionization values in an attempt to bridge the gap existing between theory and experiment in this field, this paper deals with the derivation of new wave functions corresponding to energies from the continuum part of the He spectrum, which are more accurate than those resulting from the commonly adopted approximations. (auth)

17417 PHOTON INTERACTION WITH A HOMOGENEOUS CONSTANT MAGNETIC FIELD. A. Minguzzi (CERN, Geneva). Nuovo cimento (10), 19: 847-9(Feb. 16, 1961). (In English)

The interaction of a photon field with a constant and homogeneous magnetic field is discussed and compared with previous theoretical data. This discussion is centered around the analyticity properties in the variable $\sqrt{e^2h_{\mu\nu}h_{\mu\nu}}$, branch points of the indices of refraction, and the time life of the process $\gamma \rightarrow \gamma' + \gamma''$. (N.W.R.)

17418 THEORY OF SOLID He^4. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 122: 726-38(May 1, 1961).

Using a phenomenological approach, it is shown first that solid He^4 in equilibrium with liquid He^4 II along the phase separation line, as well as at pressures somewhat above the melting pressure, should have anomalous thermal properties over a finite temperature range or, at least, at isolated temperatures. Such a behavior of the solid results from a correlation of thermodynamic character of its thermal properties with those of the anomalous liquid. The predicted anomalies of the solid will then be effectively verified in terms of rigorous thermodynamics and somewhat incomplete data available on liquid and solid He^4 along the melting line over a finite temperature interval. A specific anomaly of the melting pressure consisting in a shallow temperature minimum will be predicted at low temperatures, where both the liquid and solid phases are assumed to exhibit normal static thermal properties. The persistence of the anomalous equilibrium properties of liquid He^4 II on solidification will be discussed qualitatively as suggesting a similar origin of these anomalies in both phases, such a situation having been shown previously to exist with respect to the thermal anomalies of liquid and solid He^3. (auth)

17419 GROUND STATE OF LIQUID HELIUM (MASS 4) Fa Yueh Wu and Eugene Feenberg (Washington Univ., St. Louis, Mo.). Phys. Rev., 122: 739-42(May 1, 1961).

A numerical solution for He^4 is computed and compared with the explicit approximate solution derived by Abe. Using the computed u(r) and a proper smooth extrapolation of g(r) into the region below the apparent cutoff at r = 2.34 A, the kinetic energy of liquid He^4 at absolute zero is estimated at 2.91×10^{-15} ergs/atom. A functional J(du/dr) is constructed with the property that Abe's integral equation for du/dr is just the Euler equation associated with the problem of finding a u for which J takes on an extreme value. The extreme value of J (actually a maximum) is simply related to the expectation value of the kinetic energy. The variational property is used to determine the best u(r) from a family of trial functions. The calculated value of the kinetic energy and the measured total energy are used, in conjunction with the virial theorem, to determine the coefficients of a 6-n Lennard-Jones potential. At n = 12, the calculation yields a deeper potential well and a slightly wider repulsive region than is calculated from the properties of the gas phase. (auth)

17420 STUDY OF THE INTERNAL FIELDS ACTING ON IRON NUCLEI IN IRON GARNETS, USING THE RECOIL-FREE ABSORPTION IN Fe^{57} OF THE 14.4-kev GAMMA RADIATION FROM Fe^{57m}. R. Bauminger, S. G. Cohen, A. Marinov, and S. Ofer (Hebrew Univ., Jerusalem). Phys. Rev., 122: 743-8(May 1, 1961).

The shape of the recoil-free absorption spectrum obtained in iron garnet absorbers is investigated, using, as a source, a Co^{57} source embedded in stainless steel. The results confirm the existence of two iron sublattices each showing a Zeeman structure characterized by different parameters. No significant differences are detected between the Zeeman structure in yttrium iron garnet and dysprosium iron garnet. The values obtained for the effective magnetic field at the Fe^{57} nuclei at room temperature are 3.90×10^5 gauss and 4.85×10^5 gauss for the d and a iron lattice sites, respectively. At liquid air temperature the corresponding fields are 4.6×10^5 and 5.4×10^5 gauss, respectively. The mean value of the chemical shift for the d sites relative to stainless steel is about 0.04 ± 0.005 cm/sec and about 0.06 ± 0.005 cm/sec for the a sites. (auth)

17421 PHOTOCHEMISTRY OF THE V_1 CENTER. J. D. Kingsley (Univ. of Illinois, Urbana). Phys. Rev., 122: 772-8(May 1, 1961).

A series of photochemical experiments on the color centers present in KBr and KCl after exposure to x rays at 80°K is discussed. These experiments are chemical in nature with the reactions being triggered through exposure to radiation of various wavelengths. It is shown that the only V center which has a large electron capture cross section is the V_K center and the cross section of the V_1 center is very small. It is also shown that the destruction of the V_1 center does not involve the annihilation of an electron or hole trapped at a crystal imperfection but apparently involves the addition of an interstitial to the F center, yielding as a product the undisturbed lattice. The implications of these observations as they relate to the structure of the V_1 center are discussed. (auth)

17422 SCINTILLATION RESPONSE OF ACTIVATED INORGANIC CRYSTALS TO VARIOUS CHARGED PARTICLES. R. B. Murray and A. Meyer (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 815-26(May 1, 1961).

Experimental studies of the response of activated ionic crystals such as NaI(Tl) and CsI(Tl) to heavy charged particles indicate decreasing scintillation efficiency with increasing particle mass, and a nonlinearity in pulse height versus energy for heavier particles. Recent experiments indicate that the scintillation efficiency to electrons, however, is less that that to protons. In an attempt to account for these effects, this paper presents a calculation based on a model of the process of energy transfer from the incoming particle to the activator sites. In this model, the energy carriers are taken to be excitons resulting from recombination of electron-hole pairs in the wake of the particle. The migration of carriers to activator sites is described by a one-velocity diffusion equation in which the density of unoccupied activator sites, N_a, is a function of space and time. The diffusion equation is coupled with a second differential equation describing the time dependence of N_a. The solution to these equations indicates that the depletion of available activator sites by a particle with high dE/dx can account for observed saturation effects. This model further contains the activator concentration as a parameter, and permits a prediction of scintillation efficiency as a function of both dE/dx and concentration. The low scintillation efficiency to electrons is predicted as a consequence of the smaller recombination probability for particles of very low dE/dx. Finally, for a low-dE/dx particle in a crystal of 0.1-mole-percent activator concentration the diffusion length of energy carriers is found to be of order 20 A. (auth)

17423 MAGNETIZATION AND ELECTRICAL RESISTIVITY OF ERBIUM SINGLE CRYSTALS. R. W. Green, S. Legvold, and F. H. Spedding (Ames Lab., Ames, Iowa). Phys. Rev., 122: 827-30(May 1, 1961).

The magnetic properties of erbium single crystals (hcp) grown by the Bridgman method are determined in fields up to 18 kilo-gauss with the field applied parallel to and perpendicular to the c axis at 4.2°K and between 20.4°K and 300°K. The c axis was found to be the direction of easy magnetization. A Néel point was observed at 85°K. The ferromagnetic-antiferromagnetic transition temperature inferred from the magnetic data was 19.6°K. The saturation moment, $\sigma_{\infty 0}$, obtained by extrapolation of the c-axis data was 8 Bohr magnetons compared to the theoretical 9. Electrical resistivity measurements from 1.3°K to 300°K with the current parallel to the c axis showed a sharp increase in resistivity at 20.4°K, the ferromagnetic-antiferromagnetic transition temperature; a large peak occurred at 53.5°K, and a minimum occurred at the Néel point. The a-axis resistivity curve showed a change in slope at the Néel point and was well behaved elsewhere. (auth)

17424 SPECIFIC HEAT OF LIQUID He^3 DOWN TO 0.054°K. Myron Strongin, George O. Zimmerman, and Henry A. Fairbank (Yale Univ., New Haven). Phys. Rev. Letters, 6: 404-6(Apr. 15, 1961).

The specific heat of liquid He^3 is measured down to 0.054°K, in an attempt to detect the presence of a phase transition to a superfluid state. Such a transition should cause a discontinuous jump in the specific heat by a factor of about 2; no discontinuity of this type is observed. (T.F.H.)

17425 CYCLOTRON RESONANCE IN INDIUM. J. G. Castle, Jr., B. S. Chandrasekhar, and J. A. Rayne (Westinghouse Research Labs., Pittsburgh). Phys. Rev. Letters, 6: 409-10(Apr. 15, 1961).

Single crystals of In below 2.1°K are exposed to magnetic fields of 0 to 8 kgauss along the [111] axes. Microwave resonance studies indicate cyclotron absorption peaks that correspond to carriers having several values of effective

mass. The results are analyzed in terms of the effective carrier masses and the face-centered-tetragonal crystal structure of In. (T.F.H.)

17426 SIGN OF KNIGHT SHIFT IN SAMARIUM INTERMETALLIC COMPOUNDS. J. A. White and J. H. Van Vleck (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 6: 412-13(Apr. 15, 1961).

The Knight shift for $SmAl_2$ is found to change sign at T_{co} = 150°K, in going from 77°K to room temperature. This anomalous reversal is explained on the basis of second-order Zeeman effect (temperature-independent paramagnetism). Neglecting crystalline field effects, the sign of the shift is expected to reverse at $T_{co} \cong 300$°K. Effects of the crystalline field on T_{co} are suggested. (T.F.H.)

17427 THERMAL CONDUCTIVITY OF LIQUID He^3. A. C. Anderson, G. L. Salinger, and J. C. Wheatley (Univ. of Illinois, Urbana). Phys. Rev. Letters, 6: 443-6 (May 1, 1961).

The thermal conductivity (K) of He^3 is measured from 0.026 to 0.2°K around 10 cm Hg. Below 0.04°K, it is found that $K \sim 1/T$; the data below 0.04°K are correlated to the quasi-particle model. (T.F.H.)

17428 SUPERCONDUCTIVITY OF Nb_3Sn IN PULSED FIELDS OF 185 KILOGAUSS. V. C. Arp (National Bureau of Standards, Boulder, Colo.), R. H. Kropschot, J. H. Wilson, W. F. Love, and R. Phelan. Phys. Rev. Letters, 6: 452-3 (May 1, 1961).

The superconductivity of Nb_3Sn wires in pulsed axial magnetic fields up to 185 kgauss is studied, from 1.6 to 4.0°K. A linear dependence of the critical current on the applied field is found at each temperature. The effect of transverse magnetic fields is discussed. (T.F.H.)

17429 SUPERCONDUCTING TUNNELING ON BULK NIOBIUM. M. D. Sherrill and H. H. Edwards (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 6: 460-1(May 1, 1961).

Tunneling effects are observed in superconducting Nb-Nb oxide-Pb sandwiches. The current (I) and $\Delta I/\Delta V$ across the dielectric Nb oxide films (~50A) are found as functions of voltage (V). A maximum in $\Delta I/\Delta V$ is found around V = 2.75 to 2.85 mv, at temperatures from 4.2 to 1.9°K respectively. This maximum is correlated with the superconducting energy gap in Nb. (T.F.H.)

17430 EXCITATION OF H 2s BY ELECTRON IMPACT. D. G. Hummer and M. J. Seaton (University Coll., London). Phys. Rev. Letters, 6: 471-2(May 1, 1961).

The cross section for production of H 2s atoms by electron bombardment of ground state H atoms is calculated. The total cross section is the sum of the direct excitation and the higher excitations followed by cascades to the 2s state. Born approximations are used to find the cascade cross sections, and the direct cross section is obtained from a previous experiment. Electron incident energies up to 700 ev are considered. (T.F.H.)

17431 RELATIVISTIC HYDRODYNAMICS OF THE DIRAC MATTER. PART I. GENERAL THEORY. Takehiko Takabayasi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), Suppl. No. 4, 1-80(1957). (In English)

The hydrodynamical model of Dirac matter is formulated and clarified. The basic equations are cast in various forms. Some characteristic features of the hydrodynamics are the distinctions between proper mass density and rest particle density and also between particle momentum and velocity, primarily specified by the θ behaviors. The energy-momentum conservation law also manifests a new structure. This quantum effect is interpreted as mechanical stress and flow of heat taking place inside the fluid. The theory provides a new directly physical point of view concerning various transformation properties of the Dirac field. Furthermore it reveals a conspicious quasi-symmetrical property of the Dirac field existing between velocity and spin. The theory is formulated for cases of Dirac matter under external electromagnetic field and also of interacting Dirac and electromagnetic fields. It is manifestly gage-independent in both cases. The theory is worked out only for the case of c-number Dirac field. The mathematical method is systematized to establish how the Dirac field can be manipulated solely with the set of tensor quantities which are related to the Dirac spinor as its bilinear covariants. (N.W.R.)

17432 THE LUMINESCENT PROPERTIES OF LITHIUM FLUORIDE ACTIVATED BY URANIUM. L. M. Belyaev, Z. B. Perekalina, V. N. Varfolomeeva, V. P. Panova, and G. F. Dobrzhanskii (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 5: 722-5(Mar.-Apr. 1961).

A study was made of the luminescence and absorption spectra of LiF—U single crystals grown by the Kyropoulos method in an open crucible with different activator concentrations. In the activator concentration range from 0.01 to 0.03%, an effect of the redistribution of the intensity among the bands was discovered in the luminescence spectrum. At the same time, the absorption spectrum is shifted into the longer-wave region. It is shown that luminescence may be used for studying the growth processes of impurity crystals. (auth)

17433 INFLUENCE OF CRYSTALLIZATION CONDITIONS ON THE DISTRIBUTION OF THALLIUM IN SINGLE CRYSTALS OF SODIUM IODIDE. E. R. Dobrovinskaya and L. G. Éidel'man (All-Union Research Inst. of Chemical Reagents, Kharkov). Soviet Phys.-Cryst., 5: 734-7(Mar.-Apr. 1961).

The distribution of thallium concentration along the axis of single crystals of NaI(Tl), grown by the Stockbarger method, is investigated. In the case where the convection mechanism of impurity transfer predominates, with curved isothermal surfaces in the melt, the theoretical formula, derived on the supposition of perfect mixing in the liquid phase, is satisfied. When there is a sharp limitation in the intensity of the convection currents in the liquid phase, the experimental data agree with the theoretical curve for the case where diffusion is the only mechanism of impurity transfer. It is shown that the distribution of thallium concentration in the volume of scintillation crystals of NaI(Tl) can be controlled for the purpose of increasing the spectrometer properties of the crystals. (auth)

17434 THERMODIFFUSION IN D_2—HT AND OTHER HYDROGEN MIXTURES. J. Schirdewahn, A. Klemm, and L. Waldmann (Max-Planck-Institut für Chemie (Otto-Hahn-Institut), Mainz). Z. Naturforsch., 16a: 133-44(Feb. 1961). (In German)

With a Clusius-Dickel separation tube in which the research gas, at most 230°C, has contact only with glass, mercury, and stopcock grease in order to avoid exchange, the thermodiffusion factor α of HT and DT in D_2 and of HT in H_2 was measured. The numerical values were related to the known diffusion factor $\alpha(D_2,H_2) = 0.15$. A strong enrichment of HT in D_2 on the hot side, $\alpha(D_2,HT) = 0.028$, and a smaller enrichment, with respect to D_2, of HT in H_2 on the cold side, $\alpha(HT,H_2) = 0.11$, were observed. This is remarkable considering the equal masses of HT and D_2. Also, $\alpha(DT,D_2) = 0.042$ was measured. The thermodiffusion factors in binary mixtures of isotopic hydrogen molecules

can be represented uniformly when α_{12} is divided into two fractions, a translation fraction and a rotation fraction corresponding to the formula $\alpha_{12} = 0.25(m_1 - m_2)/(m_1 + m_2) + 0.20(\theta_1 - \theta_2)/(\theta_1 + \theta_2)$, where m is mass and θ the moment of inertia of a molecule. (tr-auth)

17435 RANGE OF Li^8 IONS OF ENERGY 40–450 KEV IN HYDROGEN, DEUTERIUM, AND HELIUM. H. G. Clerc, H. Wäffler, and F. Berthold (Max-Planck-Instituts für Chemie (Otto-Hahn-Institut), Mainz). Z. Naturforsch., 16a: 149-54(Feb. 1961). (In German)

The range-energy relation for Li^8 ions was determined from 40 to 450 kev for H_2, D_2, and He as a stopping gas. The results for H_2 and He are shown to be in satisfactory agreement with the stopping cross sections of Li^7 ions, as determined by Allison and Littlejohn. If the effect of nuclear elastic collisions is taken into account, the experimental differences between the ranges in H_2 and D_2 follow closely the theoretical predictions. An extension of the range-energy relation for Li ions of mass 6 and 7 is presented. (auth)

17436 PAIR PRODUCTION BY SLOW CHARGED PARTICLES IN THE COULOMB FIELD. E. Hara (Max-Planck-Instituts für Chemie (Otto-Hahn-Institut), Mainz). Z. Naturforsch., 16a: 155-61(Feb. 1961). (In German)

The pair creation cross section for heavy particles in the Coulomb field is calculated using Schrödinger-Coulomb wave functions for the heavy incident particles and plane waves for the created pair. It is shown that the order of magnitude of the cross section thus obtained is given by the product of the value deduced by Heitler and Nordheim with Born approximation, and the Sommerfeld correction factor, which is known for the emission of bremsstrahlung. The total cross section is computed for proton energies of 8 mc^2, 12 mc^2 and 16 mc^2. It turns out to be smaller than the result of Heitler and Nordheim by several orders of magnitude. (auth)

17437 NEW CALCULATION OF THE BINDING ENERGY OF THE HYDROGEN MOLECULE. H. Diehl and S. Flügge (Institut für Struktur der Materie, Marburg a.d. Lahn, Ger.). Z. Physik, 162: 21-7(1961). (In German)

The procedure of quantum mechanical treatment of a three-body problem described in the preceding paper by Diehl, Flügge, Schröder, Völkel and Weiguny was specialized to the ground state in which the eigenfunction only depends upon the three distances between the particles. The solution of the Schrödinger equation was approximated by variational methods, using the electronic functions of Finkelstein and Horowitz, and of Guillemin and Zener, but including the nuclear vibration in the trial function. (auth)

17438 THE DIRECTION DEPENDENCE OF THE SCINTILLATION LIGHT YIELD OF THIN ANTHRACENE AND STILBENE CRYSTALS IN COLLISIONS WITH α PARTICLES. P. H. Heckmann, H. Hansen, and A. Flammersfeld (Universität, Göttingen, Ber.). Z. Physik, 162: 84-92(1961). (In German)

The scintillation light yield of thin anthracene and stilbene crystals bombarded with α particles of ThB is investigated. A strong dependence of the light yield on the direction of incidence with respect to the crystal axes is found, confirming the results of previous measurements with thick anthracene crystals. For anthracene, maximum light yield occurs for α particles incident approximately parallel to the c′ axis. With stilbene crystals a minimum of the light output is found in the c′ direction. Furthermore, for thin anthracene crystals the direction of maximum light output depends slightly on the crystal thickness. (auth)

17439 ELECTROPHOTOLUMINESCENCE OF A ZINC CADMIUM SULFIDE PHOSPHOR IN DEPENDENCE ON EXCITATION WAVE LENGTHS AND FIELD PULSE WIDTH. H. Gutjahr and F. Matossi (Fraunhofer-Gesellschaft, Frieburg i. B. and Universität, Frieburg i. B.). Z. Physik, 162: 105-13(1961). (In German)

Luminescence flashes in an excited ZnCdS (Ag) phosphor occur when electric fields are put on or off. Whether these flashes are positive or negative depends on the length of the field pulse, on the exciting wavelength, and on the polarity of the irradiated electrode. There is a critical duration of the field pulses for which no field-off flash appears. At another but related critical time, the flashes with periodic field applications change sign. These times change with the exciting wavelength. The observations are interpreted as being controlled by the gradual filling of surface traps, which in its turn is influenced by the distribution of electron and hole concentrations produced by the incident radiation and the electric field. The critical time is approximately equal to the time needed for completely filling the surface traps. (auth)

17440 SIMULATION TESTS IN ELECTROLYTIC BATH WITH AUTOMATIC CALCULATION OF THE VOLUME CHARGE DISTRIBUTION. E. M. Fradkina and A. V. Kozyukov. Zhur. Tekh. Fiz., 31: 283-5(Mar. 1961). (In Russian)

The flow of concentrated copper sulfate ($\rho = 1.1$) under electrolytic forces in a copper container with coaxial cylindrical walls acting as electrodes was studied. The rotation induced in the fluid by crossed electric (radial) and magnetic fields was investigated. The viscosity of the liquid as a function of temperature and the flow rate as functions of external magnetic field intensity and current are plotted. (R.V.J.)

17441 FREQUENCY MULTIPLICATION BY USE OF PLASMA COLLAPSING. O. G. Zagorodnov, Ya. B. Fainberg, A. M. Egorov, and L. I. Bolotin (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukr. SSR). Zhur. Tekh. Fiz., 31: 297-300(Mar. 1961). (In Russian)

Frequency multiplication by "collapsing" a plasma is analyzed. Oscillograms of the signals produced are included. Waves with $\lambda < 4.6$ cm were achieved by collapsing the H_{011} wave ($\lambda = 10.55$ cm) in a rectangular resonator. (R.V.J.)

17442 THE INFLUENCE OF MAGNETIC FIELD ON THE SHAPE OF PENETRATING PLASMA BOUNDARY AND FOCUSING. M. D. Gabovich and L. I. Romanyuk (Kiev Inst. of Physics, Academy of Sciences, Ukr. SSR). Zhur. Tekh. Fiz., 31: 315-20(Mar. 1961). (In Russian)

The influence of a magnetic field on plasma boundary configuration is analyzed. It is shown that a magnetic field can improve or impair plasma focusing, depending on the boundary configuration. It is suggested that injecting plasma through remote instead of centrally located openings should improve focusing properties and eliminate some of the influence of magnetic fields. (R.V.J.)

17443 INVESTIGATION OF HIGHFREQUENCY DISCHARGE IN PROTON SOURCE. R. M. Komarov and V. I. Petrov. Zhur. Tekh. Fiz., 31: 321-6(Mar. 1961). (In Russian)

The effects of gas pressure in a highfrequency proton source on electron temperature T_e, ionization density n_i, discharge absorption power W, and ion current I_M were studied. The experiments were carried out with and without constant magnetic fields. It was established that with diminishing gas pressure T_e increases considerably; the magnitudes n_i, W, and I_M vary during passage through certain pressures. A transverse magnetic field reduces T_e,

increases n_i and W, and prolates I_M at pressures below 35 to 40 μ mercury. It also reduces the optimum pressure in the source to 12 to 14 μ in contrast to 23 μ in the absence of magnetic field. Longitudinal magnetic fields have little influence on discharge characteristics. (tr-auth)

17444 ELECTRICAL CHARACTERISTICS OF HIGH-FREQUENCY DISCHARGE IN ARGON AND VAPOR OF POTASSIUM IN A CONSTANT MAGNETIC FIELD. S. D. Vagner, A. I. Zudov, and A. D. Khakhaev (Petrozavod State Univ., [USSR]). Zhur. Tekh. Fiz., 31: 336-42(Mar. 1961). (In Russian)

Effects of magnetic fields on highfrequency discharge parameters in argon and potassium vapors were measured by a double probe method at various pressures. (R.V.J.)

17445 SOME CHARACTERISTICS OF ION BEAM FROM HIGH-FREQUENCY SOURCE. V. I. Petrov. Zhur. Tekh. Fiz., 31: 348-51(Mar. 1961). (In Russian)

The conditions under which hydrogen ion beams of ~7 mamp current pass through a probe channel are analyzed. The divergence at the source exit was measured, and the percentages of fast neutral particles and H_1^+, H_2^+, and H_3^+ ions were determined. (tr-auth)

17446 MEASURING OF ELECTRON GAS TEMPERATURE AND CONCENTRATION OF CHARGED PARTICLES IN NEON PULSE DISCHARGE. V. S. Egorov (Leningrad State Univ.). Zhur. Tekh. Fiz., 31: 352-6(Mar. 1961). (In Russian)

Excited atom concentrations on $^3P_{2,1,0}$ and $^1P_1$ levels of neon at various times during pulsed discharge at current density $\simeq$100 amp/cm^2 and pressure of several millimeter mercury were observed. An attempt was also made to measure electron temperature and charged particle concentration. The experiment installation is described, and the results of n_e and T_e measurements are given. Measurements of T_e under various conditions and at various stages of discharge are tabulated as well as the field magnitudes along the discharge axis. Ne density data were used for evaluating the charged particle concentrations. (R.V.J.)

17447 DISINTEGRATING MERCURY COOLING OF ELECTRON GAS IN PLASMA. L. A. Fedoseeva and V. L. Granovskii (Lenin Moscow All-Union Electro-technical Inst.). Zhur. Tekh. Fiz., 31: 357-66(Mar. 1961). (In Russian)

The relation of T_e and n_e to the time factor in deionization of mercury discharge plasma in the pressure range 1 to 58×10^{-3} mm and at a discharge current of 1.3 amp was studied. The abating laws for n_e determined by probe measurements and by oscillograms of pure ion current proved to be identical. At initial deionization stages T_e drops faster with increased pressure. In the deionization process, the difference $T_e - T_g$ slowly diminishes, but equilibrium was not reached after 400 μsec. The higher the pressure the lower the finite temperature. Calculations show that inelastic first order shocks play the most important part in electron gas cooling in the initial stages of the process, at all pressures and with p = 1 to 5×10^{-3} mm. Elastic losses prevail at later stages of the process when $p > 10 \times 10^{-3}$ mm. Metastable atoms play an important part in both initial and later stages. (R.V.J.)

17448 IONIZATION OF SINGLE CHARGED IONS AND ATOMS OF Ne AND Kr BY COLLISION WITH INERT GAS ATOMS. I. P. Flaks (Ioffe Leningrad Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Tekh. Fiz., 31: 367-75(Mar. 1961). (In Russian)

The total cross sections of free electron σ_- and slow secondary ion σ_+ production in single collisions of Ne^+ and K^+ and Ne^0 and Kr^0 with the atoms of inert gases were measured at 3 to 30 kev. The obtained data were used to determine total cross sections for electron capture by ions σ_0 and cross sections for atom stripping σ_1. According to Firsov's theory the σ_- cross section does not depend on the charge of the initial particle. A relatively small difference found in σ_- for ion-atom and atom-atom collisions is related to the individual properties of the interacting particles. The total cross sections of free electron production and atom stripping reach their maximum for collisions between like atoms. (Ne^0–Ne, Kr^0–Kr). (tr-auth)

17449 EMITTING OF PHOTOELECTRONS UNDER THE ACTION OF SOFT γ-RAYS. A. S. Ganeev and I. M. Israilev. Zhur. Tekh. Fiz., 31: 376-82(Mar. 1961). (In Russian)

The total photoelectron yield coefficients for thick Al, Ag, Ta, and W cathodes under the action of 4 to 9 kev x rays were measured, and the relations of photoelectron yield to x-ray energy and angle of incidence were found. (tr-auth)

17450 NON-STATIONARY PROCESSES IN CATHODE DISPERSION BY TUBE ELECTROMETER WITH A HIGH-TIME CONSTANT. V. I. Veksler (Lenin Central-Asian State Univ., Tashkent). Zhur. Tekh. Fiz., 31: 387-8(Mar. 1961). (In Russian)

The method and results are given from studies made of nonstationary processes in cathode dispersion for Mo bombardment by Cs^+ at 2.15 kev. (R.V.J.)

17451 TECHNIQUES OF HIGH ENERGY PHYSICS. David M. Ritson, ed. Interscience Monographs and Texts in Physics and Astronomy. Volume V. New York, Interscience Publishers, Inc., 1961. 549p. $16.75.

A general review is given of current high-energy radiation detection and measurement methods. Visual techniques, such as the diffusion cloud chamber, the bubble chamber, and the nuclear emulsion are studied; and electronic methods, such as ionization counters, scintillation counters, and Cherenkov counters are also examined. Uses of digital computers in calculations and transistors in circuits are described. Attention is given to beam optics, beam monitoring, target properties and preparation, and properties of particles and radiations. (T.F.H.)

17452 GENERAL PROPERTIES OF PARTICLES AND RADIATION. David M. Ritson (Massachusetts Inst. of Tech., Cambridge). p.1-58 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The techniques of detection and measurement of elementary particles and ionizing radiation are summarized. Methods utilizing interactions with electric, magnetic, nuclear Coulomb fields, or media are discussed, as are kinematic, time-of-flight, and energy loss methods. It is noted that measurements may be made photographically or electronically. (T.F.H.)

17453 DIFFUSION CLOUD CHAMBERS. R. Schluter (Massachusetts Inst. of Tech., Cambridge). p.55-86 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The theory, properties, and uses of the diffusion cloud chamber are reviewed. It operates continuously, over a wider range of pressures (up to 40 atm) and with shorter recovery times than the cyclic cloud chamber. Designs of specific chambers are presented. (T.F.H.)

17454 BUBBLE CHAMBERS. I. A. Pless (Massachusetts Inst. of Tech., Cambridge). p.87-113 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The theory, properties, and uses of bubble chambers are reviewed. The sensitive times, cycling times, and types of liquids used are discussed, and the pressure and temperature effects on these properties are studied. It is noted that each cycle of the bubble chamber is independent of other cycles, so that there is no cumulative radiation effect. (T.F.H.)

17455 NUCLEAR EMULSIONS. Moldred Widgoff (Brown Univ., Providence). p.115-205 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The properties and uses of nuclear emulsions as radiation detectors are reviewed. The major advantages of emulsions are their continuous sensitivity and high stopping power. Various types and grades of emulsions are discussed, and the taking and processing of emulsion data is outlined. (T.F.H.)

17456 DIGITAL COMPUTERS. D. O. Caldwell (Massachusetts Inst. of Tech., Cambridge) and J. E. Flanagan. p.207-69 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

Uses of digital computers to analyze high-energy experimental data from bubble and cloud chambers and other detectors are reviewed. (T.F.H.)

17457 IONIZATION COUNTERS. R. Wilson (Harvard Univ., Cambridge, Mass.). p.271-99 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The properties and uses of ionization counters and proportional detectors are studied. The electrostatics of pulse formation, the electronics of the counter circuitry, and comparison of ionization devices with scintillators are outlined. Examples of ionization-chamber uses are given. (T.F.H.)

17458 SCINTILLATION AND ČERENKOV COUNTERS. PART I. David M. Ritson (Massachusetts Inst. of Tech., Cambridge). PART II. R. Weinstein (Northeastern Univ., Boston). p.301-64 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The theory, properties, and uses of scintillation and Cherenkov counters are studied. The efficiency of each counter for various radiations is reviewed. Examples of counter arrangements are given. (T.F.H.)

17459 USE OF TRANSISTORS IN HIGH-ENERGY PHYSICS RESEARCH. V. L. Fitch (Princeton Univ., N. J.). p.365-402 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The theory, properties and uses of p-n-p junction transistors and p-n junctions are studied; the uses of these devices are discussed in high-speed circuitry involved in counting high-flux high-energy particles. Transistors are compared to electronic tubes as to power requirements, counting rates, life spans, and response speeds. (T.F.H.)

17460 BEAM OPTICS. D. Luckey (Massachusetts Inst. of Tech., Cambridge). p.403-63 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

The theory and techniques of high-energy beam optics are studied. Devices for forming the incident beam and the spectrometric mechanism used to separate the scattered particles are included in the study. The limitations on optical systems at high energies are examined. (T.F.H.)

17461 TARGET PREPARATION. G. S. Janes (Avco Research Lab., Everett, Mass.). p.465-85 of "Techniques of High Energy Physics." David M. Ritson, ed. New York, Interscience Publishers, Inc., 1961.

Important aspects of choice and preparation of target materials for high-energy uses are examined. Chemical, physical, and economic availability, reaction yield rate, competing reaction rates, target shapes, and other physical properties of the target are considered. Gaseous, liquid, and solid targets are studied. Problems unique to target systems are discussed. (T.F.H.)

17462 LIQUID AND SOLID ^{3}He. E. R. Grilly and E. F. Hammel (Los Alamos Scientific Lab., N. Mex.). p.113-52 of "Progress in Low Temperature Physics." Volume III. C. J. Gorter, ed. Amsterdam, North-Holland Publishing Co., 1961. (In English)

Various theories of liquid and solid helium-3 isotopes are compared and discussed. Pressure-volume-temperature relations, thermal properties, transport properties, nuclear spin relaxation in condensed He^3, and velocity of sound in He^3 are also presented. (95 references) (N.W.R.)

17463 MASSIVE LEAKAGE IRRADIATOR. Eugene P. Wigner, Leo Szilard, Robert F. Christy, and Francis L. Friedman (to U. S. Atomic Energy Commission). U. S. Patent 2,986,510. May 30, 1961.

An irradiator designed to utilize the neutrons that leak out of a reactor around its periphery is described. It avoids wasting neutron energy and reduces interference with the core flux to a minimum. This is done by surrounding all or most of the core with removable segments of the material to be irradiated within a matrix of reflecting material.

Astrophysics and Cosmology

17464 (AFOSR-403) THE STELLAR WIND REGIONS. E. N. Parker (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Nov. 1960. Contract AF 18(600)-666. 53p.

From the observations of the solar wind and of the M-giant α-Herculis the gross dynamical features of the stellar wind regions associated with class G main sequence and M-giant stars are given for various interstellar environments. The supersonic wind from a class G star undergoes a shock transition to subsonic flow at a radial distance of 10^2-10^3 a.u. and may extend many times farther as a subsonic flow. This subsonic flow will be subject to turbulence and other instabilities in many cases. The wind from an M-giant may extend many parsecs if the M-giant phase of evolution lasts long enough for its wind to approach equilibrium; the resultant interstellar contamination and heating is important for a distance of many parsecs. A rough calculation of the cavity formed by a stellar wind in a large-scale interstellar field is carried out, and it is found that the cavity shape and dimensions for stationary flow depend upon the back pressure at infinity. As the pressure increases, the cavity changes from a circular cylinder of infinite radius, through an increasingly bulbous shape of finite radius, to a sphere of infinite radius with one finite cylindrical channel from each pole. (auth)

Cosmic Radiation

17465 (EFINS-61-3) COSMIC RAY PRODUCTION OF LOW ENERGY GAMMA RAYS. Frank C. Jones (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Jan. 1961. Contract AF18(600)-666. 63p. (AFOSR-405)

An attempt was made to detect and measure any vertically incident flux of low-energy (0.25 to 10 Mev) gamma rays that might be present at high altitudes. The experiment consisted of a series of balloon flights carrying a phoswich

gamma spectrometer with pulse height recording to altitudes of about 5.5 g/cm^2 atmosphere depth. Directional sensitivity was obtained by placing a lead collimating shield around the detector and by periodically opening and closing a lead shutter above the opening of the shield. At altitudes between 5.4 and 6.0 g/cm^2 atmospheric depth the experiment yielded a value of 0.000 ± 0.034 photons sec^{-1} cm^{-2} sterad^{-1} for the vertical flux of gamma rays in the vicinity of 0.5 Mev energy. This is a null result; however, it places a new upper limit on the vertical gamma flux that is lower than any previously reported for this energy region. At lower altitudes it was observed that gamma rays are generated by cosmic rays in the atmosphere and in the collimating lead shield. At an atmospheric depth of 300 g/cm^2 the flux of gamma rays from the atmosphere was about 0.3 photons sec^{-1} cm^{-2} sterad^{-1}. There was found convincing evidence that the gamma rays of atmospheric origin were generated by the secondary nucleonic component and that they are not genetically related to the electromagnetic or "soft" component of the secondary cosmic rays. (auth)

17466 RADIOACTIVE SPECIES PRODUCED BY COSMIC RAYS IN IRON METEORITES. M. Honda, J. P. Shedlovsky, and J. R. Arnold (Univ. of California, La Jolla). Geochim. at Cosmochim. Acta, 22: 133-54(Mar. 1961).

The radioactive isotopes Be^{10}, Al^{26}, Cl^{36}, K^{40}, and Mn^{53} were measured in four iron meteorites: Grant, Williamstown, Odessa, and Canyon Diablo. Each sample was recycled to constant activity, using a different chemistry for each recycle wherever possible. The samples were counted with a low-level β-counter, except for Mn^{53} whose x-rays were measured. The isotope ratios were approximately constant for each meteorite, except for Mn^{53} where a depth effect is visible. The cosmic-ray ages of Williamstown and Grant are about the same. (auth)

17467 THE STRUCTURE OF EXTENSIVE AIR SHOWERS NEAR THE AXES. Shuji Fukui (Nagoya Univ., Japan). J. Phys. Soc. Japan, 16: 604-15(Apr. 1961). (In English)

The lateral distribution of electrons and the mean energy of extensive air showers (EAS) were observed with a detector array composed of 14 scintillation detectors, 15 Čerenkov detectors, an arrival direction detector, and a neon hodoscope. In particular the precise structure near the axes could be detected by the neon hodoscope. Each EAS was specified by various parameters, that is, the lateral distributions of electrons and energy flow, μ mesons, and nuclear active component, and it was found that the structure of EAS differ from case to case. Near the axis the lateral distributions of electrons are rather flat and varied gradually from $r^{-0.4}$ to $r^{-1.0}$ according to the distance from the axis, up to a few meters. The slope of the distribution between 5 and 50 m distance from the shower axis is well fitted to that predicted from the Nishimura-Kamata theory, adjusting the value of the s-parameter. The observed lateral distribution of electron mean energy is expressed by $E = 7.5 \times 10^8 \times r^{-0.7\pm0.1}$ ev in the region from the axis to 7 m. The probable influences on the structure near the axis are discussed. (auth)

17468 ON A CONSEQUENCE OF THE TWO-CENTRE MODEL OF COSMIC RAY JETS. E. M. Friedländer (Inst. of Atomic Physics, Bucharest). Nuovo cimento (10), 19: 818-20(Feb. 16, 1961). (In English)

The two-cone structure of cosmic-ray jets is given a consistent interpretation by assuming that the mesons are radiated independently and isotropically from two hot centers moving away from each other with Lorentz factor $\bar{\gamma}$ in the c.m.s. of the colliding nucleons. It is shown that the concept of meson-nucleon collisions is not introduced in the two-center model but that the basic assumptions of this model automatically imply a close relationship between $\bar{\gamma}$ and the structure of the collision partners. (N.W.R.)

17469 EXTREMELY ENERGETIC COSMIC-RAY EVENT. John Linsley, Livic Scarsi, and Bruno Rossi (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 6: 485-7(May 1, 1961).

An energetic cosmic ray event was analyzed using a hexagonal array of scintillators enclosed in a 2 km^2 area. The date of the event, though unspecified, was between Sept., 1959 and May, 1960. The event was recorded at the M.I.T. station near Albuquerque. The shower center, radius, axis direction, composition, and arrival times at various counters are given. A model for the event is suggested. (T.F.H.)

17470 DELAYED PROPAGATION OF SOLAR COSMIC RAYS ON SEPTEMBER 3, 1960. J. R. Winckler, P. D. Bhavsar, A. J. Masley, and T. C. May (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 6: 488-91(May 1, 1961).

Class 3 solar flares were observed at 0706 and 2234 U. T. Sept. 2, 1960 and 0040 U. T. Sept. 3, 1960. Cosmic radiation from the third flare was required to pass through or around the clouds formed by the first 2 flares. The cosmic radiation from the Sept. 3 flare was documented by rockets, balloons, and ground stations at several latitudes. A Forbush decrease, x-radiation, and radioemission associated with the flares and clouds are studied. (T.F.H.)

17471 ROCKET OBSERVATIONS OF SOLAR PROTONS ON SEPTEMBER 3, 1960. L. R. Davis, C. E. Fichtel, D. E. Guss, and K. W. Ogilive (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev. Letters, 6: 492-4(May 1, 1961).

The proton spectra of a solar cosmic radiation event were measured at Fort Churchill, Manitoba, Canada. The event occurred at 2100 U. T. Sept. 3, 1960; it was caused by a solar flare at 0040 U. T. Nike-Cajun sounding rockets were fired at 1408 and 1730 U. T. and reached an altitude of 130 km. Emulsion and Geiger counter data were presented, for proton energies of 2 to 250 Mev. Riometer data were given for the total beam. (T.F.H.)

17472 HEAVY NUCLEI IN SOLAR COSMIC RAYS. C. E. Fichtel and D. E. Guss (Goddard Space Flight Center, Breenbelt, Md.). Phys. Rev. Letters, 6: 495-7(May 1, 1961).

The spectra of nuclei with $1 < Z < 18$ in a solar cosmic radiation event were measured. The event occurred at 2100 U. T. Sept. 3, 1960; it was caused by a solar flare at 0040 U. T. Emulsion data from a Nike-Cajun sounding rocket, which was fired at 1408 U. T. and reached an altitude of 130 km, were presented. A range and δ-ray analysis of these data yields the charge and rigidity of the nuclei. (T.F.H.)

17473 ORIGIN OF COSMIC RAYS. Satio Hayakawa, Kensai Ito, and Yoshinosuke Terashima (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 6, 1-92(1958). (In English)

An attempt is made to draw a systematic view of the origin of cosmic rays. On the basis of the composition of primary cosmic rays and the galactic radio emission, arguments are presented that the galactic cosmic rays are stored in a galactic halo of spherical shape for a mean lifetime of about 10^8 years. The local sources of cosmic rays consist of the following: supernovae at which about 10^{-6} of ejected particles are accelerated to cosmic ray energy; supergiant and red giant stars at which the above ratio seems to be 10^{-8} to 10^{-7}. The chemical composition

of cosmic rays from the latter is equal to that of the interstellar matter, while the former sources are responsible for the overabundance of heavy nuclei in cosmic rays. The view is summarized and detailed problems are discussed. (auth)

17474 THE LATERAL AND THE ANGULAR STRUCTURE FUNCTIONS OF ELECTRON SHOWERS. Koichi Kamata and Jun Nishimura (Scientific Research Inst., Tokyo and Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 6, 93-155(1958). (In English)

Lateral and angular distribution functions of electron showers are derived analytically with and without the Landau approximation including ionization loss. Tables and the numerical results of these functions are presented, and their results are applied to the analysis of high energy cosmic ray phenomena. Relations between the present theories and others are discussed critically, and it is shown that other theories can be regarded as special cases of the theory presented. (auth)

17475 ANNUAL DEPOSITION OF COSMIC RAY PRODUCED Be^7 AT EQUATORIAL LATITUDES. Rama Thor and P. K. Zutshi (Tata Inst. of Fundamental Research, Bombay). Tellus, 10: No. 1, 99-103(1958). (In English)

The concentration of cosmic ray produced Be^7 in rain water was measured at two stations in the equatorial latitudes. Its rate of deposition at the earth's surface is estimated to be about 5×10^5 atoms cm^{-2} yr^{-1} and the deposited quantity seems to be independent of latitude. (auth)

Criticality Studies

17476 (LA-2044(Del.)) PLUTONIUM-METAL CRITICAL ASSEMBLIES. G. A. Jarvis, G. A. Linenberger, and H. C. Paxton (Los Alamos Scientific Lab., N. Mex.). May 1956. Declassified with deletions May 13, 1960. Contract W-7405-Eng-36. 34p.

The two plutonium-metal critical assemblies that were studied at Pajarito Site are Jezebel, bare plutonium, and Popsy. A plutonium core in a thick normal uranium reflector. These assemblies and their properties are described. (auth)

Elementary Particles and Radiations

17477 (EFINS-60-62) POLARIZATION OF $\bar{p}$ IN $\bar{p}C$ SCATTERING. P. K. Srivastava (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Nov. 1960. Contract AT(11-1)-264. 8p.

A vector meson with 3π resonance is used in the estimation of the polarization of antiprotons scattered from a carbon target. The optical model is used to calculate the scattering amplitude. The polarization equation is $p(\theta) = 2\,\mathrm{Re}gh^*/(|g|^2 + |h|^2)$, which gives an average polarization of 11.4% for $\bar{p}$-C scattering at 160 Mev. The $\bar{p}$-p polarization is also calculated and an average polarization of 39% is obtained at 1.6 Bev/c between 5 and 20°. (D.L.C.)

17478 (JINR-D-635) ON SUPPRESSION OF TWO MESON ANNIHILATIONS IN ANTIPROTON-PROTON INTERACTION. E. O. Okonov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 7p.

It is shown that the different suggestions advanced to account for the suppression of the $\bar{p} + p \rightarrow \pi^- + \pi^+$ reaction may be experimentally distinguished. In the framework of these suggestions the annihilations with K-production are discussed and the corresponding experiments are proposed. (auth)

17479 (JINR-R-643) ON EXPERIMENTAL CHECK OF THE SELECTION RULE $\Delta I = 1/2$ FOR LEPTONIC DECAYS OF K-MESONS. D. V. Neagu, E. O. Okonov, N. I. Petrov, A. M. Rozanova, and V. A. Rusakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 14p.

A relative probability of the $K_2^0 \rightarrow e^\pm + \pi^\pm + \nu$ decay was estimated by using a cloud chamber with a plate. This decay was found to constitute 46 ± 11% of all decays into charged products. Four electron-positron pairs were found with large opening angles, and an analysis was made of the pairs. It is shown that these events should be treated as a direct experimental indication to the existence of the $K_2^0 \rightarrow \pi^0 + \pi^0 + \pi^0$ decay, so far underserved. The absolute probability of the $K_2^0 \rightarrow e^\pm + \pi^\pm + \nu$ decay which was found by the mean lifetime of the K_2^0 was in agreement, within experimental error, with the twofold absolute probability of the $K^+ \rightarrow e^+ + \pi^0 + \nu$ decay. This pointed to the extension of the selection rule $\Delta I = 1/2$ to the leptonic decays of mesons (K). The estimation of the absolute probability of the $K_{\mu 3}$ decay also agreed with the selection rule. (auth)

17480 (JINR-D-651) PION-KAON SCATTERING IN THE LOW-ENERGY REGION. P. S. Isaev and M. V. Sewerynski (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 9p.

In the approximation of the effective-range theory, the explicit expressions for S and P phase shifts of the $\pi - K$ scattering are derived. (auth)

17481 (JINR-D-653) ELECTRIC AND MAGNETIC POLARIZABILITIES OF THE NUCLEON. V. S. Barashenkov, H. J. Kaiser, and A. A. Ogreba (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 6p.

The elastic (α) and magnetic (β) polarizabilities of a nucleon were determined to be 12×10^{-43} cm^3 and -0.2×10^{-43} cm^3, respectively. Reaction diagrams which contribute to the polarizability are given. The results are compared with previous determinations. (B.O.G.)

17482 (JINR-D-655) ON THE COULOMB EXCITATION OF THE Λ-PARTICLE. B. N. Valuev (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 6p.

The electromagnetic transition $\Lambda \rightarrow \Sigma^0$ which is interesting in investigating possibilities of experimental determination of the Σ^0-particle life time and of testing charge independence for strange particles (reactions $\Lambda + He_2^4 \rightarrow \Sigma^0 + He_2^4$, $\Lambda + d \rightarrow \Sigma^0 + d$) is considered. (auth)

17483 (JINR-D-684) ON THE MINIMUM NUMBER OF PARTIAL WAVES IN COLLISIONS WITH MORE THAN TWO PARTICLES IN THE FINAL STATE. Ding-chang Hsien and Jung-mo Chen (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 11p.

An inequality obtained by Grishen and Ogievetski for two-particle reactions was generalized to include reactions with more than two particles in the final state. This inequality was use to determine the minimum number of partial waves participating in a reaction with more than two particles in the final state. In order to use this inequality it would be necessary to measure the total partial cross section of a channel reaction with a definite number of particles in the final state and the angular distribution of an identified particle in the final state with respect to the incident direction in the center-of-mass system. (M.C.G.)

17484 (JINR-E-656) SPACE AND CHARGE PARITIES OF THE PROTON-ANTIPROTON SYSTEM AND ITS PION ANNIHILATION. M. I. Shirokov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 13p.

Some experiments with three and four pion annihilations of polarized antiprotons on hydrogen are suggested to define space and charge parities of the proton-antiproton system. (auth)

17485 (JINR-D-678) SEARCH FOR THRESHOLD ANOMALIES IN THE ENERGY DEPENDENCE OF THE TOTAL CROSS SECTION FOR PROTON-PROTON INTERACTION. Yu. D. Prokoshkin, V. I. Rykalin, and I. M. Vasilevskii (Vasilevski) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 8p.

An attempt was made to find anomalies in the energy dependence of cross sections for two-particle scattering in the vicinity of the thresholds for pair production of pions in proton-proton collisions. A differential ionization chamber was used to record the protons. The magnitude of the relative deviation of the measured cross section from the curve of the energy dependence averaged over a wide energy range is plotted. There were no anomalies in the energy dependence of the total cross section for the p-p interaction which would exceed the error in measurements (0.1%). (M.C.G.)

17486 (NP-10065) HIGH ENERGY INTERACTIONS OF ELEMENTARY PARTICLES. Physics Monographs, VII. G. Puppi (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1960. 134p.

Lectures at the Latin American School of Physics, June 27–August 7, 1960.

Lectures are presented in which information is given on the phenomena associated with the low energy region, an intermediate region, and a true high energy region which extends from a few Bev upward. (J.R.D.)

17487 (UCRL-9563) TWO PROBLEMS OF STRUCTURE IN THE THEORY OF WEAK INTERACTIONS. PART I. RADIATIVE PION DECAY INTO ELECTRONS. PART II. ELECTROMAGNETIC PROPERTIES OF A CHARGED VECTOR MESON INTERMEDIARY IN WEAK INTERACTIONS (thesis). James Allan Young (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 8, 1961. Contract W-7405-eng-48. 65p.

The possibility of distinguishing the pion structure-dependent radiation from the conventional inner bremsstrahlung radiation in the radiative decay of pions into electrons is discussed. Calculation of the photon energy spectrum and angular correlation showed that evidence for pion structure would be obtained if any photons of energy less than 70 Mev were detected in 180° coincidence with π-decay electrons. The probability of such events per unit solid angle is $\geq 0.2 \times 10^{-7}$ relative to ordinary $\pi \rightarrow \mu + \nu$ decay, if the assumption of a conserved vector current is made to relate the rate of radiative decay through the weak V-interaction to the rate of $\pi^0 \rightarrow 2\gamma$ decay. A systematic study was also made of the electromagnetic properties of charged vector mesons (B mesons). The various formalisms used to describe charged particles of spin 1 are compared, and a new first-order formulation of the Stuckelberg formalism is given. For the most general first-order Proca Lagrangian, subject to the usual symmetry requirements, redundant components were eliminated to obtain a Hamiltonian formulation. The theory was interpreted in the nonrelativistic limit, and the terms corresponding to spin-orbit coupling and electric quadrupole-moment interaction was identified. The analogy to spin 1/2 theory led to the consideration of classical spin equations of motion which agree with the quantum mechanical equations to order m^{-2}. This general form for the electromagnetic interaction was applied to a recalculation of the $\mu \rightarrow e + \gamma$ decay rate through a vector meson intermediary. It was concluded, on the basis of $\mu \rightarrow e$ conversion alone, that it is not necessary to abandon the intermediary B-meson hypothesis in weak interactions. As a means of producing B-mesons, searching for their pair production in the Coulomb field of a nucleus is proposed. By using the Weizsacker-Williams approximation, the pair-production cross section was calculated in the high-energy limit for vector mesons with gyromagnetic ratios unity and zero. This method of production is compared and contrasted with the alternative high-energy neutrino method of production. (auth)

17488 (TID-12546) THE INELASTIC SCATTERING OF MESONS AND BARYONS. Michael Nauenberg (Cornell Univ., Ithaca, N. Y. and California. Univ., Berkeley). Feb. 1960. Apr. 3, 1961. Sponsored by AEC and ONR under Contract Nonr 401-(12). 45p.

Thesis submitted to Cornell Univ.

The problem of obtaining the scattering and production amplitudes in terms of the fundamental meson-baryon coupling constants is treated. MacDowell's work is extended to include the analytic properties of partial amplitudes for inelastic as well as elastic scattering of a meson and a baryon at a fixed total angular momentum j and parity π. Using the condition of unitarity of the S matrix, an expression near any threshold energy for the partial amplitudes of $j = 1/2$ is derived in terms of a real, symmetric, and constant matrix. As examples, π-Y and $\bar{K}$-N scattering are considered. (D.L.C.)

17489 ANGULAR CORRELATION THEORY WITH JACOB-WICK METHOD. M. Micu (Inst. for Atomic Physics, Bucharest). Acta Phys. Polon., 20: 157-9(1961). (In English)

The angular correlation formula for decays of the type $A \rightarrow B + d_1$, $B \rightarrow C + d_2$ is deduced by using the development of the plane wave indicated by Jacob and Wick. The lack of Racah coefficients and of summations over the orbital angular momentum quantum numbers makes the given expression for the angular correlation simpler than the well-known expression (S. Devons and L. J. B. Goldforb 1957). (auth)

17490 DYNAMICS OF PARTICLES WITH INTERNAL "SPIN." H. Rund (Univ. of Natal, Durban, S. Africa). Ann. Physik (7), 7: 17-27(1961). (In English)

A generalized relativistic Lagrangian is suggested, which is such that the momentum vector possesses a component normal to the direction of the velocity, while the conservation of total angular momentum requires the existence of a non-vanishing internal angular momentum tensor (spin). The resulting mechanical system is very similar to the spin models of elementary particles discussed by Hönl, Papapetrou, Bopp, and others, as these emerge as special cases. Although the latter are usually derived from variational principles for which the Lagrangian depends on the acceleration, the present theory is based on a Lagrangian depending solely on position and velocity. This method avoids certain mathematical difficulties, and permits the immediate application of the Hamiltonian theory associated with such simple variational principles. Although no radiation effects are considered, the Abraham vector plays an important role in this purely mechanical theory. (auth)

17491 DIFFUSION OF RADIATION IN A MEDIUM WITH MIRROR-TYPE BOUNDARY REFLECTION. V. V.

Sobolov. Doklady Akad. Nauk S.S.S.R., 136: 571-4(Jan. 21, 1961). (In Russian)

The diffusion of radiation in a semi-infinite medium consisting of two-dimensional parallel layers and bound by a mirror-type reflecting surface with an intrinsic reflection coefficient of unity was resolved previously by a special method developed by the author. The same method is used for resolving the same equation, considering the reflection coefficient a function of the angle of deflection. (R.V.J.)

17492 YIELD FROM α-BOMBARDED MATERIALS. E. M. Tsenter. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 159-61(Jan.-Feb. 1961). (In Russian)

The relation of alpha reaction yield and specimen composition is analyzed. It is shown that in mixed substances the reaction yield from each substance does not depend linearily on its content. For homogeneous mixtures (the grains are small in comparison to the alpha path) the sign and the deflection magnitude are determined by the relation $S_2M_1/S_1M_2(>1; <1; = 1)$. For a mixture of large grains, comparable to the α path, the sign and the magnitude of deflection depend on the magnitude d_1/d_2, the component weight ratio. (R.V.J.)

17493 SOLUTION FOR REVERSE PROBLEM IN γ MEASUREMENTS. I. D. Savinskii. Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 3, 379-86(Mar. 1961). (In Russian)

The density distribution of radioactive sources is found from γ-emission data. A method, applicable to practically arbitrary distributions, is suggested for solving a reverse problem. (R.V.J.)

17494 SCATTERING OF ELECTROMAGNETIC WAVES FROM CONCENTRIC INFINITE CYLINDERS. M. Kerker and E. Matijević (Clarkson Coll. of Tech., Potsdam, N. Y.). J. Opt. Soc. Am., 51: 506-8(May 1961).

The solution for the scattering of radiant energy in the form of electromagnetic waves by concentric isotropic infinitely long circular cylinders is given for the incident energy traveling perpendicular to the cylinder axis. (auth)

17495 ON THE TRANSPORT EQUATION IN QUANTUM MECHANICS. Lesser Blum (Facultad de Ciencias Exactas y Naturales, Buenos Aires). J. Phys. Soc. Japan, 16: 616-20(Apr. 1961). (In English)

By means of a time-dependent perturbation procedure similar to that developed by Prigogine, the transport equation for a particle in a Bose-Einstein medium is obtained. This equation shows also a non-local character. (auth)

17496 A CONTRIBUTION TO THE K^+-DECAY STATISTICS. J. K. Bøggild (Univ. of Copenhagen), K. H. Hansen, J. E. Hooper, M. Scharff, and P. K. Aditya. Nuovo cimento (10), 19: 621-41(Feb. 16, 1961). (In English)

K^+-decay events in a large block of emulsions were studied, mainly by following the charged secondaries to the ends of their ranges. Emphasis was placed on: (1) obtaining unbiassed information on the high-energy end of the spectrum of the $K_{\mu 3}$ secondary; (2) a search for a decay mode $K^+ \rightarrow \mu^+ + \mu^0$; when combined with the results of earlier experiments the data were such that it should have been possible to detect the process if the branching ratio was greater than ≈5%; no positive evidence was found; (3) a search for π^+ secondaries of energy (53 to 61) Mev. Among 467 decay events there were no such secondaries. The branching ratios for the various decay modes were determined. Combining the data with those of previous experiments the following values were obtained: $B(K_{\mu 2}) = (58.6 \pm 2.6)\%$; $B(K_{\pi 2}) = (21.7 \pm 2.5)\%$; $B(K_{\pi 3}) = (7.1 \pm 0.4)\%$; $B(K'_{\pi 3}) = (2.4 \pm 0.4)\%$; $B(K_{\mu 3}) = (5.5 \pm 1.1)\%$; $B(K_{\beta 3}) = (4.7 \pm 1.1)\%$. The measured scanning efficiency in this experiment was 99%. (auth)

17497 $\bar{K}$ CAPTURE FREQUENCY IN HYDROGEN. A. A. Kamal (Osmania Univ., Hyderabad, India). Nuovo cimento (10), 19: 738-41(Feb. 16, 1961). (In English)

From the study of $\bar{K}$ capture stars in photographic emulsions, the $\bar{K}$ capture frequency in the hydrogen atom is estimated and the result is compared with the Fermi-Teller theory of the capture of negative mesons in matter. A strong disagreement is found from the expected value. This discrepancy is attributed to the transfer of the meson to an atom of the CNO group. (auth)

17498 THEORY OF THE LOW-ENERGY PION-PION INTERACTION. [PART] II. G. F. Chew and S. Mandelstam (Univ. of California, Berkeley). Nuovo cimento (10), 19: 752-76(Feb. 16, 1961). (In English) (UCRL-9126)

It is shown that when P-wave pion-pion scattering is large at low energies, the integral equations previously formulated require a cut-off. Because of the cut-off and the unstable nature of the solution, the numerical integration procedure becomes much more involved. The original equations are therefore replaced by a series of conditions at the symmetry point, and the unphysical cuts of the partial-wave amplitudes are replaced by a corresponding series of poles. Within this framework one need not speak of a cut-off, but one new parameter appears. Self-consistent solutions can be found in which a P-wave resonance is sustained by a bootstrap mechanism, that is, a strong attractive force in the I = 1 state results from the exchange of a resonating pair of P-wave pions. The symmetry-point conditions used would be modified by the cut-off and quantitative accuracy is not attempted; however, this and other corrections are not expected to change the qualitative nature of the solutions. Rough estimates of the corrections are made. (auth)

17499 SOME REMARKS ON THE PHASE-SHIFT ANALYSIS WITH D-WAVES FOR TRACK-CHAMBER HISTOGRAMS. I. Derado and R. Van de Walle (CERN, Geneva). Nuovo cimento (10), 19: 777-86(Feb. 16, 1961). (In English)

A possible new method of phase-shift analysis of track-chamber histograms is discussed. Methods available for correcting the angular distribution for Coulomb scattering and for calculating the phase-shift errors are considered. As an example of application a re-analysis is given of the π^+-scattering experiment at 310 Mev of Foote et al. (auth)

17500 ON THE PION-HYPERON RESONANCES AND ON THE POSSIBLE USES THEREOF. (DETERMINATION OF THE Σ-Λ RELATIVE PARITY AND OF THE α_Λ/α_0 RATIO). Ph. Meyer, J. Prentki, and Y. Yamaguchi (CERN, Geneva). Nuovo cimento (10), 19: 794-815(Feb. 16, 1961). (In English)

The existence of a resonance in the hyperon-pion system leads to a possibility of determining the Σ-Λ relative parity and the ratio α_Λ/α_0 of asymmetry coefficients α_Λ (in $\Lambda \rightarrow p + \pi^-$) and α_0 (in $\Sigma^+ \rightarrow p + \pi^0$). A proposal is made which allows the determination of these quantities by measuring only the up/down asymmetries of pions coming from Λ and Σ decays. Various aspects of this proposal are discussed. The possible existence of other resonances is also emphasized. In particular it is shown that the existence of a resonance in the isotopic spin state I = 1 leads to some predictions concerning the existence of another resonance, probably in the I = 2 state. (auth)

17501 SYMMETRY OPERATIONS FOR STRONG AND WEAK INTERACTIONS. V. Gupta (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 19: 821-4(Feb. 16, 1961). (In English)

The consequences of G-conjugation and S-symmetry invariances for strong interactions, linear and non-linear in the boson field, are explored. These lead to parity-conserving interactions for coupling of the [NNπ] type. The results can be extended to K-meson couplings. A new symmetry operation for weak interactions is also discussed. (auth)

17502 NUMBER OF K^+-MESONS PRODUCED IN SATURNE. J. Teiger (Centre d'Etudes Nucléaires, Saclay, France). Nuovo cimento (10), 19: 826-7(Feb. 16, 1961). (In French)

The meson (K^+) emissions are measured on targets of carbon, copper, and lead in the Saclay proton synchrotron at 0.6 Bev at an angle of 35° with the direction of the incident protons. The production data are tabulated for the three targets. (N.W.R.)

17503 A MODEL OF HYPERFRAGMENTS. G. Bhamathi and S. Indumathi (Univ. of Madras). Nuovo cimento (10), 19: 828-9(Feb. 16, 1961). (In English)

The possible hyperfragments with Σ and Ξ hyperons are studied with a view to determine the Σ-N and Ξ-N potentials. Tables of the binding energies and hyperfragments are presented for Σ^- and Ξ^-. (N.W.R.)

17504 RADIATIVE CORRECTIONS TO ELECTRON-ELECTRON AND ELECTRON-POSITRON SCATTERING. G. Furlan and G. Peressutti (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo cimento (10), 19: 830-4(Feb. 16, 1961). (In English)

The relative weight at different energies and angles of the radiative corrections due to the various terms (photon self-energy, vertex parts, two-photon exchange) is discussed using numerical data, and also the angular distributions in the c.m.s. and in the l.s. for both Moeller and Bhabha processes are given. (N.W.R.)

17505 ON THE $e^+ + e^- \rightarrow \pi^0 + \gamma$ PROCESS. G. Furlan (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo cimento (10), 19: 840-3 (Feb. 16, 1961). (In English)

The evaluation of the cross section for the reaction $e^+ + e^- \rightarrow \pi^0 + \gamma$ is discussed briefly. However, the experimental difficulties and the order of magnitude of the cross section make this process one of the least probable ones to be revealed in the near future. It would reveal some interesting information about the $\gamma\pi^0\gamma$ vertex. (N.W.R.)

17506 METHOD OF DETERMINING THE SPIN AND PARITY OF A PION-HYPERON RESONANCE. Richard H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev., 122: 929-31(May 1, 1961).

The reaction sequence, $M_1 + N_1 \rightarrow Y^* + M_2$; $Y^* \rightarrow Y + \pi_1$; $Y \rightarrow N_2 + \pi_2$ is considered, where M_1 and M_2 are spin-zero mesons, N_1 and N_2 are nucleons, Y is a Λ or Σ^+ particle, and Y^* is a pion-hyperon resonance of spin $\frac{1}{2}$ or $\frac{3}{2}$. The general form of the angular distribution of the particles π_1 and N_2 is written down under the assumption that final state interactions between the meson M_2 and the Y^* decay particles may be neglected. If any polarization of the hyperon Y exists, the spin and parity of the resonance Y^* may be determined from this angular distribution. The structure of the spin density matrix of the Y^* is discussed. (auth)

17507 HIGH-ENERGY POTENTIAL SCATTERING WITH SHORT-RANGE FORCES. B. J. Malenka (Northeastern Univ., Boston) and H. S. Valk. Phys. Rev., 122: 931-3(May 1, 1961).

An attempt is made to separate out long- and short-range effects for high-energy elastic scattering. Within the context of a high-energy approximation, expressions for the scattering amplitudes are obtained for the cases $kR \gg ka \gg 1$ and $kR \gg 1 > ka$, where R and a denote the long and short ranges, respectively. For the latter case, the entire short-range effect is included in a phenomenological S-wave term while the long-range contributions are written explicitly. (auth)

17508 INTERPRETATION OF ELASTIC π^+–p SCATTERING AT 1.1 Bev. B. J. Malenka (Northeastern Univ., Boston) and H. S. Valk. Phys. Rev., 122: 934-7(May 1, 1961).

Using a high-energy approximation, it is shown that the π^+–p elastic scattering data at 1.1 Bev can be interpreted in terms of coherent scattering produced by an absorptive Gaussian well having a root-mean-square range of the size of the proton charge radius plus a short-range interaction whose principal effect is represented phenomenologically as a contribution to the S wave. (auth)

17509 π^+–p ELASTIC SCATTERING AT 310 Mev: RECOIL-NUCLEON POLARIZATION. James H. Foote, Owen Chamberlain, Ernest H. Rogers, Herbert M. Steiner, Clyde E. Wiegand, and Thomas Ypsilantis (Univ. of California, Berkeley). Phys. Rev., 122: 948-58(May 1, 1961).

Recoil-proton polarization in π^+–p elastic scattering at 310-Mev incident-pion laboratory kinetic energy is experimentally measured at four scattering angles with scintillation counters. Polarization values obtained, related rms experimental errors, and mean center-of-mass recoil angles are: $+0.044 \pm 0.062$ at 114.2 deg, -0.164 ± 0.057 at 124.5 deg, -0.155 ± 0.044 at 133.8 deg, and -0.162 ± 0.037 at 145.2 deg. The sign of the polarization is defined to be positive when a preponderance of the recoil protons had their spin vectors pointing in the direction of $p_i \times p_f$, where this quantity is the cross product of the initial and final momentum vectors of the conjugate pions. A beam of 1×10^6 pions per sec incident upon a 1.0-g/cm^2-thick liquid-hydrogen target produced the recoil protons, which were then scattered by a carbon target at a mean energy varying with recoil angle from 113 to 141 Mev. The polarization of the recoil protons was analyzed by measuring the asymmetry produced in the carbon scattering. A proton beam of known polarization was used to determine the analyzing ability of the system at each recoil angle. Values obtained for the analyzing ability range from 0.41 to 0.57. (auth)

17510 π^+–p ELASTIC SCATTERING AT 310 Mev; PHASE-SHIFT ANALYSIS. James H. Foote, Owen Chamberlain, Ernest H. Rogers, and Herbert M. Steiner (Univ. of California, Berkeley). Phys. Rev., 122: 959-71(May 1, 1961). (UCRL-9481)

A comprehensive phase-shift analysis of π^+–p elastic-scattering data at 310-Mev incident-pion laboratory kinetic energy is performed. The experimental data utilized include measurements of the differential and total cross sections and of the recoil-proton polarization. The D-wave phase shifts were found to be definitely needed in order to attain an adequate fit to the data. A general search for phase-shift solutions was carried out, using S-, P-, and D-wave phase shifts. One solution—of the Fermi type—was found that fits the data significantly better than any of the other solutions obtained. The calculated errors in the phase shifts of this set vary from 0.4 to 0.6 deg. The effects of small nuclear F-wave phase shifts on the results of the analysis were investigated and were found to be large. The nuclear phase shifts in the original Fermi solution and their rms errors are (when F-wave phase shifts are allowed): $S_{3,1} = -17.2 \pm 2.6$ deg, $P_{3,1} = -2.9 \pm 4.0$ deg, $P_{3,3} = 135.0 \pm 0.6$ deg, $D_{3,3} = 3.1 \pm 2.6$ deg, $D_{3,5} = -4.9 \pm 2.1$ deg, $F_{3,5} = 0.5 \pm 0.6$ deg, $F_{3,7} = -0.6 \pm 1.4$ deg.

The values given here for the first five phase shifts approximate the corresponding values obtained when the F-wave phase shifts were assumed negligible. However, all except $P_{3,3}$ fall outside the limits set by the small original errors. Inelastic-scattering processes were neglected during the phase-shift analysis. Extension of the phase-shift inquiries to include G waves was attempted, but it was observed that the available data and theory do not allow the G-wave interaction to be significantly incorporated into the analysis. (auth)

17511 CHARGED-SCALAR STRONG-COUPLING THEORY FOR TWO-NUCLEON SYSTEM. K. W. Chun (Columbia Univ., New York). Phys. Rev., 122: 973-83 (May 1, 1961).

The Serber-Pais charged-scalar strong-coupling method is extended to the two-nucleon system. It is shown explicitly that whereas the nuclear force depends on the renormalized coupling constant alone at the large internucleon separations, its dependence on the unrenormalized coupling constant alone becomes increasingly pronounced as the two nucleons come closer together. (auth)

17512 CONSTRUCTION OF UNITARY SCATTERING AMPLITUDES. R. Blankenbecler (Princeton Univ., N. J.). Phys. Rev., 122: 983-92(May 1, 1961).

A general linear technique is discussed which constructs unitary scattering amplitudes without expanding in partial waves and in the presence of inelastic channels. Two- and three-particle intermediate states are discussed explicitly, but the method can be extended directly to any finite number of particles. A new approximation technique suggested by this formalism is applied to electroproduction in π-π and π-K scattering. A form of the impulse approximation is derived for both the coupled form factor and the coupled scattering amplitude problems. The nucleon and deuteron form factor system is briefly discussed. Finally, a model field theory which contains three-particle intermediate states is formulated and solved by the linear technique for purely pedagogical reasons. (auth)

17513 HELICITY OF μ-MESONS FROM π-MESON DECAY. G. Backenstoss, B. D. Hyams, G. Knop, P. C. Marin, and U. Stierlin (CERN, Geneva). Phys. Rev. Letters, 6: 415-16(Apr. 1961).

The helicity (H) of μ^- mesons produced in the decay of a beam of 12.1 Bev/c π mesons is measured. A longitudinally polarized μ^- beam strikes an iron target whose electrons are polarized magnetically. The spin dependence of the differential cross section for the μ^--electron interaction is measured by reversing the electron polarization (and spin). By energy analysis of the knock-on electrons, a calculated value of $H = +1.17 \pm 0.32$ is obtained. This value is in agreement with the predicted value of $H = +1$. (T.F.H.)

17514 PION-PION INTERACTION FROM THRESHOLD ANOMALIES IN K^+ DECAY. Paolo Budini (Università, Trieste, Italy) and Luciano Fonda. Phys. Rev. Letters, 6: 419-21(Apr. 15, 1961).

The π-π interaction cross section is estimated by means of the K^+ decay modes ($K^+ \rightarrow \pi^+ + \pi^0 + \pi^0$ and $K^+ \rightarrow \pi^+ + \pi^- + \pi^+$). At the threshold of the second reaction a cusp is observed in the spectrum of the π^+ coming from the first reaction. Analysis of this cusp effect yields information as to the π-π scattering and/or charge exchange cross sections. (T.F.H.)

17515 π-Λ RESONANCE AND THE SIGMA HYPERON. S. Barshay and H. Pendleton, III (Brandeis Univ., Waltham, Mass.). Phys. Rev. Letters, 6: 421-3(Apr. 15, 1961).

A resonance at 1385 ± 15 Mev in the π-Λ system is interpreted as a Σ hyperon, composed for a π and a Λ with -65 Mev binding energy. The coupling between a π-Λ system and a $\bar{K}$-N (nucleon) system is considered in K^--p interactions, and an S-wave phase shift is derived for the π-Λ system. The phase angle is found under the restriction that the resonance be at 1385 Mev, and the results are discussed in terms of $\pi\Lambda\Sigma$ relative spins, parities, and strangenesses. (T.F.H.)

17516 ELECTRODYNAMIC PROPERTIES OF BARYONS IN THE UNITARY SYMMETRY SCHEME. Sidney Coleman and Sheldon Lee Glashow (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 6: 423-5(Apr. 15, 1961).

The "unitary symmetry" theory proposed by Gell-Mann for strong interactions is considered. Under unitary symmetry the 8 baryons, and 7 psuedoscalar mesons plus 1 predicted psuedoscalar meson, form components of 3×3 traceless matrices, ψ and ϕ respectively. The electromagnetic terms in the Lagrangian density expression are expressed as functions of ψ and ϕ. From these terms, the magnetic moments of Σ^+, Σ^-, Σ^0, Ξ^-, Ξ^0, Λ, and the mixed moment responsible for $\Sigma^0 \rightarrow \Lambda + \gamma$ are derived in terms of nucleon magnetic moments. Similarly, a correlation between the masses of the baryons is found. (T.F.H.)

17517 POSSIBLE EFFECT OF COLLECTIVE CORRELATION BETWEEN VACUUM NUCLEONS IN PION PHYSICS. Osamu Hara (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 6: 425-7(Apr. 15, 1961).

Strong collective correlations arise in Fermi Systems with mainly attractive forces, such that the system's properties with the attractive forces are quite different from the properties of the free system. It is suggested that this effect might be important in pion physics, since internucleon (N-N) forces in vacuum are mainly attractive. The vacuum itself is changed by this effect, because the effect requires that the lowest energy nuclear state contain nucleons in positive energy levels. (T.F.H.)

17518 EVIDENCE FOR LOW RATES FOR β DECAY OF Σ^- AND Λ HYPERONS. William E. Humphrey (Univ. of California, Berkeley), J. Kirz, Arthur H. Resenfeld, J. Leitner, and Y. I. Rhee. Phys. Rev. Letters, 6: 478-81 (May 1, 1961).

The strangeness-nonconserving hyperon β decays $\Sigma^- \rightarrow e^- + n + \nu$ and $\Lambda \rightarrow e^- + p + \bar{\nu}$ and the strangeness-conserving decays $\Sigma^- \rightarrow e^- + \Lambda + \bar{\nu}$ and $\Sigma^+ \rightarrow e^+ + n + \nu$ are studied. The $\Sigma^{\pm}$ and Λ are produced in K^--p interactions in a bubble chamber. The branching ratios for the strangeness-nonconserving decays are about an order of magnitude below theoretical predictions. (T.F.H.)

17519 π^--p ELASTIC SCATTERING AT 550, 600, 720, 900, AND 1020 Mev. Calvin D. Wood, Thomas J. Devlin, Jerome A. Helland, Michael J. Longo, Burton J. Moyer, and Victor Perez-Mendez (Univ. of California, Berkeley). Phys. Rev. Letters, 6: 481-3(May 1, 1961). (UCRL-9447)

The π^--p differential elastic scattering cross sections ($d\sigma/d\Omega$) are measured at 550, 600, 720, 900, and 1020 Mev. The coefficients a_l in the cosine power series for $d\sigma/d\Omega$ are fit to the data by a least squares method to $l = 5$ at each energy. The functional dependence of a_l (for each l) on incident π^- energy is studied. (T.F.H.)

17520 LOW-ENERGY PION-PION S-WAVE PHASE SHIFTS. Bipin R. Desai (Univ. of California, Berkeley). Phys. Rev. Letters, 6: 497-500(May 1, 1961). (UCRL-9535)

Evidence is presented for an S-wave $\pi\pi$ phase shift in the isotopic spin ($I = 0$) state. The crossing symmetry relations are invoked at the symmetry point to give the

S-wave phase shifts as functions of the c.m. mementum squared, the $\pi\pi$ coupling constants, etc. The reaction $p + d \rightarrow He^3 + \pi^+ + \pi^-$ is given as an example (T.F.H.)

17521 LOW-ENERGY $\bar{K}$-NUCLEON INTERACTION. R. C. King, R. E. Lanou, Jr., S. F. Tuan (Brown Univ., Providence). Phys. Rev. Letters, 6: 500-4(May 1, 1961).

It is noted that either a constructive (a+) or destructive (a−) coulomb-nuclear interference may exist in the K-p quasi-bound-state resonance. This resonance is studied in low-energy K^--p elastic scattering, both theoretically and empirically. It is shown that the errors inherent in the S-wave zero-range approximations necessitate great care in any choice between the (a+) and (a−) solutions. (T.F.H.)

17522 $\Delta I = 1/2$ RULE IN Σ DECAY: A PROBLEM OF SIGN. S. P. Rosen (Midwestern Universities Research Assn., Madison, Wis.). Phys. Rev. Letters, 6: 504-5(May 1, 1961).

It is shown that the existence of a $\Delta I = 1/2$ rule for Σ decay can be neither proven nor disproven. This inability results from an ambiguity in the signs of certain of the interaction Hamiltonian matrix elements. It is noted that in strong interactions (such as non-mesonic hypernuclei decay) these signs become unambiguous, but that other difficulties arise. (T.F.H.)

17523 ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON. Eiji Yamada (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), Suppl. No. 5, 1-16(1958). (In English)

Investigations on the anomalous magnetic moment of the nucleon are reviewed. It is suggested that there may be some possibilities of obtaining a rather satisfactory result with the modifications of Sachs' phenomenological analysis by the inclusion of effects of nucleon pairs and K mesons. Although most of calculations show too large contributions from the nucleon current, the effect of field reactions considerably improves the result of perturbational calculation. It is noted that there arises an ambiguity in defining the anomalous magnetic moment in the nonrelativistic calculation. The charge distribution around a nucleon is also discussed briefly. (auth)

17524 PION THEORY OF THE ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON. Hiroichi Hasegawa (Gakushuin Univ., Tokyo). Progr. Theoret, Phys. (Kyoto), Suppl. No. 5, 17-40(1958). (In English)

An analysis of the anomalous magnetic moment of the electron is carried out, and many valuable suggestions are obtained for use in solving the problem of the anomalous magnetic moment of the nucleon. Also the effect of the nucleon-antinucleon pairs is studied in detail. (N.W.R.)

17525 PHENOMENOLOGICAL THEORY OF PION-NUCLEON REACTIONS. Satio Hayakawa, Masaaki Kawaguchi, and Shigeo Minami (Kyoto Univ. and Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 5, 41-64(1958). (In English)

A considerable part in the interpretation of π-N reactions can be made independently of the details of meson field theory. Such part is discussed, separating the dynamical effects of π-N interactions. A historical survey on this approach is given for the purpose of elucidating a trend of activities in Japan. Both the angular distributions of pions and the polarizations of recoil nucleons are calculated for π-N scattering and photopion production. The relations between the two reactions were investigated by using the unitarity of the S-matrix. The possible violation of charge independence expected at low energies is discussed. Although the effects of charge dependent interactions are small, except for Coulomb interference, estimates may facilitate the analysis of more accurate experiments. (auth)

17526 A NEW MATHEMATICAL FORMULATION OF QUANTUM MECHANICS IN THE FRAMEWORK OF WAVE-PACKET THEORY. TRANSFORMATION THEORY, THEORY OF SCATTERING AND FUNCTIONAL DIFFERENTIATION. Mikio Namiki and Riichi Iino (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), Suppl. No. 5, 65-122(1958). (In English)

The transformation theory of quantum mechanics is constructed on the mathematical basis of the theory of linear functionals and the physical notion of the wave-packet formalism of the theory. The wave-packet function, which is described by an indefinitely differentiable and rapidly decreasing function, specifies the regions of the values of some physical quantities corresponding to the physical situation. The wave functions or the transformation functions are considered to be the linear continuous functionals which have the wave-packet functions as their functional arguments and transform the wave-packet functions to the other ones. The dynamics of quantum mechanics is constructed on the former (the wave functions as functionals) but not on the latter (the wave-packet functions). The theory never contains improper functions and integrals. The present formalism is physically interpreted as a sort of wave-packet theory of quantum mechanics. The formal theory of scattering is formulated in the framework of this theory without resort to any ϵ-manipulation and the adiabatic assumption, in order to investigate the conditions for potentials and the behaviors of the evolution operator at infinite past and future. Finally the definition is given for the higher-order functional derivatives. They may suggest a method of treating the overlapping singularities. (auth)

17527 CONSERVATION LAWS IN THE ISOTOPIC SPIN SPACE AND THEIR VIOLATION BY THE ELECTROMAGNETIC INTERACTION. Masaaki Kato and Gyo Takeda (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 7, 35-66(1959). (In English)

The $\Sigma^+ - \Sigma^-$ mass difference and the electromagnetic correction on the $\Delta I = 1/2$ law for non-leptonic hyperon and K-meson decays are discussed, based on the assumption of charge independence for strong interactions. Simple calculation for the two phenomena reveals the difficulty that larger electromagnetic effects are needed. Various approximate conservation laws in the isotopic spin space and their implications for the understanding of non-leptonic decays are likewise discussed. (auth)

17528 ON THE STRUCTURE OF INTERACTIONS. Hiroomi Umezawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 7, 67-85(1959). (In English)

There are two ways of approaching the theory of elementary particles: One is to classify interactions according to their theoretical behaviors and another is to look into various systematics governing the interactions realized in experiments. An effort is made to combine both in suggesting many strata which seem to exist in the structure of elementary particles. A section is devoted to a theoretical classification of interactions. The strong interactions are briefly discussed, and experiments on weak interactions and their theoretical analysis are reviewed. Some features of the suggested strata which seem to play essential roles in extremely high energy phenomena are discussed. (auth)

17529 HYPOTHETICAL VELOCITY MEASUREMENTS OF A DIRAC PARTICLE. Ziro Koba (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 8, 1-20(1958). (In English)

The characteristic behavior of a wave packet of a Dirac

particle immediately after a precise position measurement, which is essentially due to the presence of inner degrees of freedom or the commutativity of the position and the velocity operators, is reinvestigated and compared with that of a fictitious one-component relativistic particle that is assumed to have only positive energy states. In order to distinguish this particle from a Dirac particle another hypothetical experiment of three successive position measurements is presented. Further, the procedure of this velocity measurement is analyzed by a three-dimensional treatment, which reveals the polarity of the Dirac electron and illustrates the non-commutativity of different components of the velocity. Finally the possibility of constructing an arbitrarily small wave packet of a Dirac particle with positive energy states only, and the possibility of applying the present analysis to bosons are discussed. (auth)

17530 SOME FEASIBLE TESTS OF QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. Steven C. Frautschi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), Suppl. No. 8, 21-32(1958). (In English)

The limits of our present knowledge of quantum electrodynamics, and the motivation for extending that knowledge, are reviewed. Precise measurements of the muon gyromagnetic ratio, and production of wide angle electron and muon pairs in hydrogen by high energy photons and electrons, are discussed as possible experiments which can extend our knowledge of electron, muon, and photon "size" to distances $\sim 0.3 \times 10^{-13}$ cm. (auth)

17531 METHOD OF MEASURING THE DIFFUSE-SCATTERING INTENSITIES OF POLYCRYSTALS. V. I. Iveronova and A. A. Katsnel'son (Moscow State Univ.). Soviet Phys.-Cryst., 5: 756-8(Mar.-Apr. 1961).

The intensity is measured for a time such that not less than 2000 or 3000 counts are registered. The white spectrum and the K_β components are removed by the monochromator; the reflected beam is treated in the same way if fluorescence is anticipated. Harmonics are suppressed by using as the monochromator a crystal of pentaerythritol (002 reflection). It is found that scattering by the agents used to bind the powder is comparable with the diffuse scattering by the powder, so no binding agent is permissible. Then the sole extraneous scattering medium is air, which scatters very much when the usual GUR system is used. Air scattering was eliminated to a considerable extent by using a special collimator between the specimen and the counter. The collimator slits isolate a narrow beam from the scattered radiation; no radiation scattered at an appreciable distance can enter the counter, and only the air very close to the specimen has any effect. This air has a volume equal to half the scattering volume of the air in the absence of the specimen, which divides the latter volume in two. The air-scattering correction is then simply half the intensity measured in the absence of the specimen. (N.W.R.)

17532 SCATTERING OF ELECTROMAGNETIC WAVES FROM THE IDEAL CONDUCTING SPHERE IN NONHOMOGENEOUS MEDIUM. Yu. S. Sayasov (Moscow Inst. of Chemical Physics). Zhur. Tekh. Fiz., 31: 261-70(Mar. 1961). (In Russian)

The cross section of plane wave scattering from an ideally conducting sphere in a heterogeneous medium was investigated, and the radiation characteristics of the system are analyzed for the case in which the primary antenna is an electric or magnetic dipole distributed on the surface of the sphere. (tr-auth)

17533 COMPARATIVE CHARACTERISTICS OF CHERENKOV TRANSITIONAL AND BREMSSTRAHLUNG RADIATION FOR SHORT WAVES. L. G. Lomise (Moscow Inst. of Radiotechnology and Electronics, Academy of Sciences). Zhur. Tekh. Fiz., 31: 301-10(Mar. 1961). (In Russian)

The efficiency of Cherenkov, transitional, and bremsstrahlung emissions were compared on the basis of calculations made for bunched electron beam emissions evaluated at given current approximations. The results indicate that in spite of electron straggling the Cherenkov radiation in the short-wave spectrum is more effective than transitional or bremsstrahlung emissions. Radiation resistance of various emitters was measured; the data are in good agreement with theory. (R.V.J.)

17534 RADIATION OF A RING WITH CURRENT UNIFORMLY PASSING THROUGH A GYROTROPIC WAVEGUIDE. L. S. Bogdankevich (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Tekh. Fiz., 31: 311-14(Mar. 1961). (In Russian)

The field and the energy loss in a Vavilov-Cherenkov ring with uniform current along a waveguide axis perpendicular to its plane were found. (tr-auth)

17535 CALCULATION OF THE SECONDARY EXTINCTION. A. V. Kuznetsov and Yu. S. Terminasov (Petrozavod State Univ. [USSR]). Zhur. Tekh. Fiz., 31: 383-6(Mar. 1961). (In Russian)

Integral reflection formulas are derived for a massive sample, considering secondary extinction and assuming equiaxial mosaic block structure and equal orientation probability. The same postulations were used for calculating the thickness of an elementary layer in the block, in which secondary extinction can be neglected. (tr-auth)

Neutron Physics

17536 (AEET/NP-1) STUDY OF THE NEUTRON SPECTRA EMERGING FROM MODERATING ASSEMBLIES. R. Ramanna and N. Sarma (India. Atomic Energy Establishment, Trombay). 1960. 25p.

The thermal neutron spectra emerging from the plane face of BeO, D_2O and H_2O moderating assemblies were measured using a slow chopper velocity selector at the Apsara reactor. The deviation of the emerging spectrum from a Maxwellian is attributed to the variation of λ with energy. The spectra emerging from D_2O and H_2O assemblies were interpreted in term of the weak and strong exchange of energy between the neutron and the molecules of the moderator as discussed by Tolstov et al. (auth)

17537 (AEC-tr-4382) A MEASUREMENT OF NEUTRON SLOWING-DOWN AREA IN LIGHT WATER. T. Naganuma, S. Ogura, M. Shimizu, H. Aisu, and T. Kondo (Mitsubishi Atomic Power Industries, Inc., Omiya, Saitama Prefecture, Japan). Translation. Apr. 1961. 11p.

The investigations were conducted for the cases of light water with and without voids by measuring the secondary moment of neutron slowing-down density at resonance energies of indium. Discussions are given of the experimental results and the theory. A comparison was made of the results to calculated values. (B.O.G.)

17538 A MECHANICAL VELOCITY SELECTOR FOR SUBTHERMAL NEUTRONS AND ITS APPLICATIONS IN THE MEASUREMENT OF THE TOTAL CROSS SECTION OF CADMIUM, SAMARIUM, EUROPIUM, AND GADOLINIUM. P. Höhne (Technische Hochschule, Munich). Ann. Physik (7), 7: 50-65(1961). (In German)

A mechanical chopper for neutrons with energy between 0.15 and 3×10^{-3} ev is described, and the data necessary for operation, such as transmission function (half-value width $0.3\lambda_0$ and transmission 57%) and neutron spectrum, were determined. The total cross sections of the four ele-

ments with low energy resonances (Cd, Sm, Eu, and Gd) were measured and compared with the theoretical values from known resonance parameters. In Gd and Cd the parameters were varied somewhat in order to obtain agreement with all known measurement points (Gd: $E_0 = 0.033$ ev, $\Gamma = 0.120$ ev, and $\sigma_0 = 44{,}000$ b; Cd: $E_0 = 0.176$ ev, $\Gamma = 0.112$ ev, and $\sigma_0 = 8000$ b). In Sm the contribution of a negative resonance was estimated ($\sigma = 48\ b\sqrt{ev}$). For Eu the parameters were newly determined to be $E_0 = -(0.063 \pm 0.014)$ ev, $\Gamma = (0.10^{+0.01}_{-0.02})$ ev, and $g\Gamma_n^0 = (0.09 \pm 0.04) \times 10^{-3}$ ev. (tr-auth)

17539 APPROXIMATE SOLUTION OF THE TRANSPORT EQUATION BY MEANS OF THE METHOD OF MOMENTS. Sh. S. Nikolaishvili. Atomnaya Energ., 10: 271-2(Mar. 1961). (In Russian)

The problem of neutron energy distribution at a given distance from an isotopic source point placed in an unbounded homogeneous medium is solved by a moments method which is comprised of kinetic equations describing slowing down and diffusion. Several of the first even spatial moments of the function are found after which an approximate concept of the function is developed with exact even moments. The above concept is developed considering the asymptotic behavior of the solution. Moreover, the three first moments of the approximate function are utilized. (R.V.J.)

17540 MEASUREMENT OF EPITHERMAL NEUTRON SPECTRA BY RESONANCE DETECTORS. Hsiang-lin Pai, Pu-yuan Ma, Shin-chen Wang, and Wellington S. Lee (National Tsing Hua Univ., Taiwan, China). Nuclear Sci. and Eng., 9: 519-20(Apr. 1961).

The neutron energy spectrum in a graphite moderator is measured from 10^{-1} to 10^3 ev. The spectrum is measured using a resonance activation technique, with 6 detectors (In, Au, I, Co, Mn, Na). The neutrons are produced by the reaction $Be^9(\gamma,n)Be^8$; the maximum neutron energy is 1.18 Mev. (T.F.H.)

17541 ABSOLUTE NEUTRON DENSITY MEASUREMENTS IN THE WWR-S "EWA" REACTOR AT ŚWIERK. Edward T. Jozefowicz (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 855-62(1960). (In English)

The theoretical principles of neutron density measurements by the activation method are briefly shown. The experimental method consisting in phosphorus activation followed by absolute measurement of its activity in liquid scintillator is described. Some results of measurements in the reactor are included. (auth)

Nuclear Properties and Reactions

17542 (AE-43) COMPARISON BETWEEN CALCULATED AND MEASURED CROSS-SECTION CHANGES IN NATURAL URANIUM IRRADIATED IN NRX. P-E. Ahlström (Aktiebolaget Atomenergi, Stockholm). Mar. 1961. 28p.

A preliminary comparison was made between calculated and measured cross section changes in rods of natural uranium irradiated in NRX. The measurements were made in the GLEEP reactor. The theory of the calculations, developed by Littler, is discussed. The investigation showed that the methods of calculating burnup presently used provide a good illustration of the long-term variations in isotope contents. A satisfactory agreement with experimental results was obtained when calculating apparent cross section changes in uranium rods due to irradiation if the fission cross section for Pu^{239} was considered to be 780b. The results obtained in this investigation were regarded as preliminary. (auth)

17543 (AWRE/LIB/BIB/1) HEAVY ION REACTIONS. AWRE LIBRARY BIBLIOGRAPHY NO. 1. Bibliography of Reports and Published Articles. Dorothy Beck (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Mar. 1, 1961. 43p.

269 references. (B.O.G.)

17544 (GAMD-1950) NUCLEAR PROPERTIES FOR FISSION PRODUCTS OF RADIOLOGICAL SIGNIFICANCE IN HTGR. H. I. Leon and D. C. Morse (General Atomics Div., General Dynamics Corp., San Diego). Jan. 16, 1961. Contract AT(04-3)-314. Project No. 32. 17p.

Data are presented on the nuclear properties of significant fission product isotopes which may escape from the HTGR fuel. For each fission product isotope the following properties are given: half-life, decay constant, total chain yields, average β energy release, and γ energy release. These data were drawn from existing literature. (M.C.G.)

17545 (IDO-16660) ADDITIONAL MEASUREMENTS OF THE REACTIVITY TRANSIENT IN IRRADIATED THORIUM. Robert G. Nisle and Dean A. Millsap (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 13, 1961. Contract AT(10-1)-205. 15p.

Reactivity measurements were made on two pairs of thorium slugs. One pair of Savannah River type slugs was irradiated in MTR in L-58 for an estimated 2.5×10^{20} nvt at an estimated flux level of 1.8×10^{14} nv. The other pair was Hanford type and was irradiated in A-5 for an estimated 6.6×10^{20} nvt at an estimated level of 2.0×10^{13} nv. Estimates of the decay constant of Pa^{233} and the U^{233} content of the slugs were made in the Reactivity Measurement Facility. It is concluded that (1) the long-term reactivity transient is due to Pa^{233} decay, (2) thorium slugs can be irradiated in MTR at flux levels of 10^{14} nv to a U^{233} content of 6 grams without damage to the slugs, and (3) the in-pile cross section of Pa^{233} can be measured by this method provided an independent measurement of the irradiating flux is made. (D.L.C.)

17546 (JINR-D-599) ON THE FUNCTIONAL EXPANSION OF THE SCATTERING MATRIX IN NORMAL PRODUCTS OF ASYMPTOTIC FIELDS. B. V. Medvedev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 22p.

The properties of the scattering matrix were investigated by the axiomatic approach, without the perturbation theory. The s-matrix was represented as a series of normal products of asymptotic field operators. Formulas were established expressing the coefficient functions of such an expansion in terms of chronological products of the current operator and some sequence of operators. Some infinite sets of coupled equations were also derived for these coefficient functions. (auth)

17547 (JINR-D-658) DETERMINATION OF THE PION-NUCLEON INTERACTION CONSTANT BY THE DIFFERENTIAL CROSS SECTION OF ELASTIC PP-SCATTERING. Yu. M. Kazarinov, V. S. Kiselev, I. N. Silin, and S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 11p.

In order to determine the pion-nucleon interaction constant f^2, data from elastic proton-proton scattering were treated at energies of 147, 330, and 380 Mev. The obtained value of f^2 at E = 147 and 380 Mev did not contradict the value $f^2 = 0.08$. No success was achieved in attempts to achieve agreement of the experimental data at 330 Mev with the value $f^2 = 0.08$. (auth)

17548 (JINR-D-673) CROSS SECTIONS FOR STRANGE PARTICLE GENERATION. V. S. Barashenkov, E. K. Mihul, and Tzu-tzan Huang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 8p.

Multiple production of strange particles was treated taking into account their resonance interactions. The law of conservation of strangeness was taken into consideration more exactly. It is shown by an example of slow antinucleon annihilation and pion-nucleon collisions at 1.7 Bev, that the theoretical cross sections for strange particle production may be brought into agreement with the experimental data. (auth)

17549 (JINR-D-682) LOW ENERGY LIMIT FOR γN SCATTERING AMPLITUDE AND CROSSING SYMMETRY. L. I. Lapidus and Kuang-chao Chou (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 9p.

The low energy limit for γN scattering amplitude was obtained with the aid of the single nucleon terms of the invariant amplitudes. The account of the crossing symmetry requirements allows deduction of the next terms by γ for $Q^2 \to 0$, as well as an expression for the limiting value of the first derivative with respect to Q^2 for $Q^2 \to 0$. (auth)

17550 (JINR-E-637) ON PROPERTIES OF A NUMBER OF STRONGLY DEFORMED NUCLEI. Lu Yang, N. I. Pyatov, V. G. Solov'ev (Soloviev), I. N. Silin, and V. I. Fourman (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 17p.

By using the improved scheme of single-particle levels of the self-consistent field, certain properties of strongly deformed nuclei in the region $150 < A < 190$ were investigated on the basis of the superfluid model. By comparing calculated pairing energies with experimental data, the pairing interaction constants having average values of $G_N = 0.18$ Mev and $G_z = 0.20$ Mev were found. The density of the single-particle low-energy levels of odd-mass nuclei was calculated. The values agreed with experimental data and were about twice as large as these presented by Nilsson's schemes. The regularities in the behavior of the low-excited states in even-even nuclei were noted. It is shown that the calculation error, which is due to the conservation of number of particles, on the average does not exceed 6%. (auth)

17551 (JINR-E-657) PAIRING CORRELATIONS AND ONE-NUCLEON REDUCED WIDTHS OF NUCLEAR ENERGY LEVELS. V. B. Belyaev and B. N. Zakhar'ev (Zakhariev) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 8p.

The pairing correlations impede the transitions allowed in the model of independent particles (MIP). At the same time they 'allow' the reactions which are strictly forbidden in the MIP. The qualitative agreement of the results with the experimental data is established. (auth)

17552 (NARF-61-4T) THE ANGULAR DISTRIBUTION OF GAMMA RAYS RESULTING FROM NEUTRON CAPTURE IN AIR. R. E. Beissner (Convair, Fort Worth, Tex.). Apr. 14, 1961. Contract AF33(600)-38946. 119p. (FZK-9-151)

An analytic procedure is presented for calculating the angular distribution of gamma rays resulting from neutron capture in air. Numerical results are tabulated for four source-detector separation distances, eight angles of emission at the sources, and fifteen initial neutron-energy groups. Agreement with Monte Carlo calculations is within the estimated accuracy of the Monte Carlo data. (auth)

17553 (NASA-TN-D-698) AN ABSOLUTE DEFINITION OF PHASE SHIFT IN THE ELASTIC SCATTERING OF A PARTICLE FROM COMPOUND SYSTEMS. Aaron Temkin (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Apr. 1961. 14p.

It is argued that the projection of the target wave function on the total wave function of a scattered particle interacting with the target system provides a definition of the absolute phase shift including any multiples of π. With this definition it can be proven rigorously that in the limit of zero energy for s-wave electrons scattered from atomic hydrogen, the triplet phase shift must approach a nonzero multiple of π. It can be further shown that at least one π of the phase shift is not related to the existence of a bound state of the H-ion. (auth)

17554 (NP-10040) THE STRUCTURE OF THE NUCLEON CORE BY THE HARTREE APPROXIMATION. PART I. Y. Takahashi (Dublin Inst. for Advanced Studies). 1960. 19p.

A method is proposed for investigation of the structure of the nucleon core. A set of equations was derived to define the nucleon core and the meson cloud simultaneously. The equations were formulated by a variational method which gave an approximate solution. The size of the nucleon core was estimated for a non-relativistic nucleon interacting with a neutral scalar meson. The coupling constant between nucleon and meson was given by the ratio of the size of the core and the cloud. It is shown that for $f^2/4\pi \sim 1$, the nucleon core size may be half that of the meson cloud, where the number of mesons around the nucleon is about one. The generalization to a more realistic case is also suggested. The renormalization is not considered. (auth)

17555 (NP-10064) LOW ENERGY NUCLEAR PHYSICS. INTERACTION OF γ-RAYS WITH NUCLEI. Physics Monographs No. VIII. J. Goldemberg and A. O. Hanson (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1960. 63p.

Lectures at the Latin American School of Physics, June 27–August 7, 1960.

A compilation of lectures is presented. Included is information on the interaction of γ radiation at 30 Mev with nuclei, residual activity, inverse reactions, electron disintegration, inelastic electron scattering, and absorption measurements. Other information is given on particle yields from photo nuclear reactions at 22 Mev, cross-sections, energy spectrum and angular distribution, elastic scattering, and polarized bremsstrahlung. (J.R.D.)

17556 (NYO-9681) PION PRODUCTION AND THE SECOND PION-NUCLEON RESONANCE. Charles J. Goebel and Howard J. Schnitzer (Rochester, N. Y. Univ.). Mar. 10, 1961. Contract AT(30-1)-875. 68p.

A model for the reaction $\pi + N \to 2\pi + N$ at low energies, which includes π-π interaction and final state interactions in the (3,3) state, is discussed. The theory involves two parameters which are related to the S-wave and P-wave π-π scattering lengths. These parameters are chosen from a fit to the total cross section for $\pi^- + p \to \pi^- + \pi^+ + n$. Meson production is predicted to be primarily in the $T = 1/2$ state. Predictions are made for the total cross sections of the various channels (e.g. $\pi^+ + p \to \pi^+ + \pi^+ + n$, etc.) in the energy range from threshold to ~500 Mev, in good agreement with experiments. Angular distributions are predicted which are in qualitative agreement with the π^+ angular distribution for $\pi^- + p \to \pi^- + \pi^+ + n$. From these data it is suggested that S wave π-π scattering length has opposite sign to P wave scattering length. A conjecture concerning

rapidly rising inelastic cross sections in a single partial wave is made to connect the large T = 1/2, $D_{\frac{3}{2}}$ production cross sections with the T = 1/2, $D_{\frac{3}{2}}$ π-N resonance. The π-π scattering length found are $a_0 = -0.290\mu^{-1}$, $a_1 = 0.122\mu^{-1}$ and $a_2/a_0 = 2/5$ by hypothesis. (auth)

17557 (OOR-2543:3) THEORETICAL EVALUATION OF THE VARIANCE OF THE CORRELATION METHOD FOR THE TWOFOLD PROMPT RADIOACTIVE DECAY CHAIN WITH NONCONSTANT SOURCE. Wesley O. Doggett and Gary T. Smith (North Carolina State Coll., Raleigh). Dec. 1960. Contract DA-01-009-ORD-820. 51p.

A time correlation method for investigating two connected nuclear disintegrations is studied. The method permits the investigation of daughter activities in equilibrium with long lived parents without the count rate restrictions imposed on the usual coincidence method by the occurrence of accidental coincidences. The average value and variance of the correlation measurement are theoretically evaluated for the case of a prompt parent-daughter cascade with negligible background in which the parent decay during the experiment is not negligible. (auth)

17558 (SCR-245) TABLE OF ATOMIC MASSES. J. W. Guthrie, ed. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1961. 302p.

An extensive table of atomic masses on the C^{12} = 12.000000 scale is presented. Multiple-charged species, dimers, some higher polymers, and compounds are included. Relative abundances are tabulated along with the masses and their square roots. (D.L.C.)

17559 (TID-12446) $O^{16} + O^{16}$ ELASTIC SCATTERING. P. G. Roll, E. Newman, and F. E. Steigert (Yale Univ., New Haven. Sloane Physics Lab.). [Apr. 10, 1961]. 49p.

Differential cross sections for the elastic scattering of 9.65, 7.37, and 5.66 Mev/amu oxygen ions from a gaseous oxygen target were measured over a range of laboratory angles from about 2 to 11°. Using a simple diffraction model and a nuclear radius of $1.34\ A^{\frac{1}{3}} \times 10^{-13}$ cm = 3.37×10^{-13} cm, a good fit was obtained to the positions of the maxima and minima of the angular distributions. In addition, this analysis gave qualitative agreement with the absolute magnitude of the measured cross section at 9.65 Mev/amu. Attempts to fit the data with a sharp cutoff model were not as successful. By modifying this model with an imaginary nuclear phase shift to produce a diffuse cutoff, the agreement was somewhat improved. Linear and exponential shapes for the edge of the nuclear surface were equally satisfactory, and resulted in cutoff radius parameters which were larger than that obtained from the diffraction analysis, and which increased with decreasing energy. The radial diffuseness parameters Δ R obtained from these calcualtions ranged from 0.51×10^{-13} cm at 9.65 Mev/amu to 0.23×10^{-13} cm at 5.66 Mev/amu, in reasonable agreement with those obtained from optical model calculations. (auth)

17560 (TID-12490) THE NUCLIDES A^{42} AND Cl^{39}. Nelson Jarmie and M. G. Silbert (Los Alamos Scientific Lab., N. Mex.). [1960?]. 5p.

The masses of Cl^{39} and Ar^{42} and the energies of their first excited states were determined by an investigation of the reactions $Ar^{40}(t,\alpha)Cl^{39}$ and $Ar^{40}(t,p)Ar^{42}$. The results for Ar^{42} are: mass excess (M-A) = −34.423 ± 0.040 Mev (C^{12} = 0) or −21.990 ± 0.040 Mev (O^{16} = 0); energy of first excited state = 1.138 ± 0.030 Mev. The results for Cl^{39} are: mass excess (M-A) = −29.772 ± 0.040 Mev (C^{12} = 0) or −18.227 ± 0.040 Mev (O^{16} = 0); energy of first excited state = 0.364 ± 0.030 Mev. The Q values of $Ar^{40}(t,p)$ and $Ar^{40}(t,\alpha)$ were found to be 7.046 ± 0.040 and 7.259 ± 0.040 Mev, respectively. (auth)

17561 (TID-12547) A MEASUREMENT OF THE $O^{16}(n,p)N^{16}$ CROSS SECTION. K. W. Seemann and W. E. Moore (Knolls Atomic Power Lab., Schenectady, N. Y.). [1960]. 9p.

Presented at the American Physical Society Meeting, Washington, D. C., April 24-27, 1961.

Preliminary results are given for an experiment for measuring the energy dependence of the $O^{16}(n,p)$ cross section. The cross section was measured by bombarding an O_2-containing liquid scintillator in ring geometry, transferring the scintillator to a shielded vessel, and detecting the N^{16} beta decay. For a neutron energy of 14.4 Mev, the cross section was determined to be 34 ± 4 mb. Details of the experimental procedure and apparatus are described. (D.L.C.)

17562 (TID-12549) CALCULATION OF INELASTIC NEUTRON SCATTERING FROM Zr^{90} AND Nb^{93}. D. T. Goldman (Knolls Atomic Power Lab., Schenectady, N. Y.). [1960]. 22p.

The cross section for the excitation of the levels of Zr^{90} by means of inelastic neutron scattering was calculated. The method for determination of spins and parities used in the calculation is described. In the case of Nb^{93}, the spins and parities of the first four levels were previously determined. The compound cross sections for the excitation of various Nb^{93} levels by neutron scattering were calculated using penetrabilities determined from the nuclear potential. (J.R.D)

17563 (TID-12550) ELASTIC AND INELASTIC SCATTERING OF NEUTRONS BY Al^{27}. C. R. Lubitz and D. T. Goldman (Knolls Atomic Power Lab., Schenectady, N. Y.). [1960]. 4p.

Calculations of cross sections for excitations of the various Al^{27} levels are presented for neutron energies of 2.5 and 4.4 Mev. The optical model parameters used were determined in a previous study by fitting the total and differential cross sections of 7 and 14 Mev neutrons scattered from Mg^{24}. The calculated data are presented tabularly. (J.R.D.)

17564 (WASH-1031) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, LOS ALAMOS SCIENTIFIC LABORATORY, FEBRUARY 20-21, 1961. John A. Harvey (Nuclear Cross Sections Advisory Group, AEC). Feb. 1961. 82p.

A collection of reports is presented which contains informal statements of recent developments, changes of emphasis, and preliminary data that are of importance to the AEC cross section measurement program. Reports are included from Argonne, Brookhaven, Hanford, Los Alamos, ORNL, and Phillips petroleum company. Other contributors include Columbia, Duke, Rice, and California universities. (J.R.D.)

17565 THE EFFECT OF MAGNETIC FIELD MODULATION ON NUCLEAR POLARIZATION IN THE OVERHAUSER EFFECT. K. H. Rädler (Universitat, Leipzig). Ann. Physik (7), 7: 45-9(1961). (In German)

It was shown that the calculation of nuclear polarization in the Overhauser effect with and without a magnetic field modulation leads to considerably different results, which only agree approximately when the line broadening of the electron resonance greatly exceeds the modulation amplitude. (tr-auth)

17566 CROSS-SECTIONS OF (d,p) REACTIONS. M. Z. Maksimov. Atomnaya Energ., 10: 260-2(Mar. 1961). (In Russian)

Theoretical magnitudes and available data on angular distributions from (d,p) reactions are generalized, and

semiemperical formulas, useful for determining the cross sections of the reactions are derived. The developed function graphs for theoretical and experimental data on various nuclei show a smooth curve. The coefficients $C_{d,p}$ determined by the derived formulas are tabulated for 21 isotopes. It was found that for most nuclei, these coefficients are close to unity (1 to 0.6). For cases of heavy nuclei and large deuteron energies (>10 Mev), the direct knock-out of intrinsic nucleons should be considered in addition to stripping and compound-nucleus formation. The results show that the derived formulas can be effectively utilized for evaluating the yield of (d,p) reactions. (R.V.J.)

17567 THEORY OF THE EFFECTIVE CROSS-SECTIONS OF HEAVY NUCLEI IN THE REGION OF PARTIAL OVERLAP BETWEEN NEUTRON RESONANCES. A. A. Luk'yanov and V. V. Orlov. Atomnaya Energ., 10: 262-4 (Mar. 1961). (In Russian)

A method is offered for calculating cross sections in the region of partial overlap. The problem is reduced to dispersion-type corrections to the mean cross section. The corrections determine the effective cross section as functions of absorber concentration and temperature. A case in which the Doppler width is larger than the total resonance width (characteristic to heavy nuclei) is analyzed. The relation of U^{238} and U^{235} concentrations in an infinite medium at 300°K, at which the total temperature effect is positive, was determined as $\rho 8/\rho 5 \leq 0.675$. The result seems to be more realistic than the previously reported magnitude 1.87. (R.V.J.)

17568 CAPTURE CROSS-SECTIONS OF Nb, Ni, AND Fe FOR FAST NEUTRONS. Yu. Ya. Stavisskii and A. V. Shapar. Atomnaya Energ., 10: 264-5(Mar. 1961). (In Russian)

The energy dependence of fast neutron capture in Nb, Ni, and Fe isotopes was measured. The results show a very weak dependence of capture cross sections on energy at 150 to 1000 kev. This is attributed to neutrons possessing orbital moments different from zero and to radiation width broadening with increased energy. (R.V.J.)

17569 SOME COMMENTS ON THE MEASUREMENT OF PHOTONEUTRON YIELDS FOR THICK SPECIMENS. V. I. Gomonai, D. I. Sikora, and V. A. Shkoda-Ul'yanov. Atomnaya Energ., 10: 265-6(Mar. 1961). (In Russian)

The yield of photoneutrons from an infinitely thick target was calculated by means of equilibrium Belenkii-Tamm spectra, using data on the excitation functions for (γ,n) reactions in lead. It was assumed that the magnitude of (γ,n) reactions in lead remains constant at 22 to 30 Mev and is equal to the magnitude assumed for 18 to 22 Mev. The theoretical and experimental data on photoneutron yields per fission from copper (2.0×10^{-4} n/e) and uranium (1.0×10^{-4} n/e) were compared, and it is shown that the equilibrium Belenki-Tamm spectrum can be effectively utilized at the above energies. (R.V.J.)

17570 NEW ISOTOPES OF EMANATION AND FRANCIUM: Em^{223}, Em^{224}, AND Fr^{224}. Alfredo V. Bellido Postigo (Universidad Nacional de San Agustin, Arequipa, Peru). Bol. inform. junta control energía atómica (Peru), 6: No. 31, 55-66(Jan.-Feb. 1961). (In Spanish)

An examination of the products from the interaction of thorium with 230-Mev protons shows evidence of the existence of three new isotopes with excess neutrons: Rn^{223}, Rn^{224}, and Fr^{224}. Their existence was confirmed by identifications of their decay products, Ra^{223} and Ra^{224}. (tr-auth)

17571 PRECISE FORM OF THE β SPECTRUM OF Au^{198}. Pierre Depommier and Marc Chabre (Université, Grenoble, France and Centre d'Études Nucleáires, Grenoble, France). Compt. rend., 252: 1587-9(Mar. 13, 1961). (In French)

The form factor of the β spectrum of Au^{198} is represented by the formula $S = (1 + g(W_0 - W))^2$ with $g = 0.034 \pm 0.004$, $W_0 = 962 \pm 1$ kev. The β spectrum of Na^{24} was studied as a spectrometer test. (tr-auth)

17572 TRIPLE SPONTANEOUS DIVISION OF CURIUM-242. N. A. Perfilov, Z. I. Solov'eva, R. A. Filov, and G. I. Khlebnikov (Khlopin Radium Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 581-2(Jan. 21, 1961). (In Russian)

A spontaneous triple fission of Cm^{242} was recorded in fine-grain emulsion. Only long-track α particles were recorded in the photolayer. Calculations of the energy distribution of 182 α particles with tracks >30μ and considering the losses in the filter, $E_{\alpha\ min} = 11$ Mev. With corrections for geometry, the data do not differ greatly from data on U^{235} thermal neutron fission. Considering complex fissions events, the amount of active substance in the layer, and the exposure, the probability that <11 Mev α particles would be produced is 1 : 340 ± 40. Corrections for α particles of < 11 Mev energy, not observed in the experiment, increase the probability ratio to about 1 : 300. (R.V.J.)

17573 α-PARTICLE BRANCHING RATIOS FOR NEUTRON-DEFICIENT ASTATINE ISOTOPES. R. M. Latimer, G. E. Gordon, and T. D. Thomas (Univ. of California, Berkeley). J. Inorg. & Nuclear Chem., 17: 1-5(Apr. 1961). (In English) (UCRL-9217)

The ratio of the number of α-particle disintegrations to the total number of disintegrations (α-branching ratio) was measured for $At^{202 to 206}$. The values of these ratios are 0.120 for At^{202}, 0.138 for At^{203}, 0.0452 for At^{204}, 0.184 for At^{205}, and 0.0088 for At^{206}. The over-all half lives are in agreement with previously reported values except for that of At^{206}, which was found to have a half life of 29.5 min rather than the reported 22 min. (auth)

17574 THE NEUTRON CAPTURE CROSS SECTIONS OF ^{149}Sm AND ^{150}Sm. K. L. Aitken and F. W. Cornish (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 17: 6-11(Apr. 1961). (In English)

The effective neutron cross section of Sm^{149} was determined in three different reactor positions by measuring mass spectrometrically the amount of Sm^{150} formed by neutron capture. Analysis of the results shows that the effective cross section of Sm^{149} in a well-thermalized neutron spectrum of known temperature can be calculated to within ±2%. The cross section of Sm^{150} in a thermalized spectrum at 50°C with r = 0.0015 is found to be 102 ± 5 barns. (auth)

17575 THE α-HALF-LIVES OF ^{244}Cm, ^{245}Cm, AND ^{246}Cm. W. T. Carnall, S. Fried, and A. L. Harkness (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 17: 12-14(Arp. 1961). (In English)

The A-half life of Cm^{244}, determined from specific activity measurements, and the α-half lives of Cm^{245} and Cm^{246}, determined by mass spectrometric analysis of curium and its plutonium daughters, are determined to be 17.59 ± 0.06 years, 9320 ± 180 years, and 5480 ± 170 years, respectively. (auth)

17576 THALLIUM ISOTOPES 192 AND 193. G. Anderson, I. B. Häller, and R. Ringh (Univ. of Uppsala). J. Inorg. & Nuclear Chem., 17: 15-19(Apr. 1961). (In English)

Half lives of Tl^{192} and Tl^{193} were determined by following the decay of conversion electron lines from mass separated

sources in a β spectrometer. From energy level systematics an (11.4 ± 1.4) min period is ascribed to a 7+ level in Tl^{192}; most likely the ground state has the same half life within the limits of error. Predicted M4 isomers in Tl^{193} and Tl^{191} could not be confirmed. The ground state half life of the former isotope was obtained as (22.6 ± 1.0) min, while that of the latter seems to be less than 10 min. An improved half life of Au^{191}, (3.2 ± 0.1) hr, is reported. (auth)

17577 THE α/β BRANCHING RATIO OF ^{241}Pu. H. L. Smith (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 17: 178-80(Apr. 1961). (In English)

The α/β disintegration ratio of Pu^{241} is $2.31 \pm 0.10 \times 10^{-5}$ and partial β- and α-half lives are 13.3 ± 0.3 years and $5.6 \pm 0.2 \times 10^5$ years, respectively. Three samples prepared from stock solution, after back-extraction with water, were directly evaporated or electroplated on platinum for α- and β-counting, comparison fission counting, or α-pulse analysis. The branching ratio is given by the expression

$$\frac{Pu^{241}\ \alpha\text{-disintegration rate}}{(1/\lambda_{Am}) \times Am\ growth\ rate) + Am\ decay\ rate},$$

but in this case the Am decay rate was neglected since it was about 10^{-4} of the first. (N.W.R.)

17578 HALF-LIFE OF 134m Cs AND THE CROSS-SECTION FOR ITS FORMATION BY NEUTRON ACTIVATION. B. Keisch (Phillips Petroleum Co., Idaho Falls, Idaho). J. Inorg. & Nuclear Chem., 17: 180-2(Apr. 1961). (In English)

The thermal neutron cross section of Cs^{133} to produce Cs^{134m} is redetermined to have a value of 2.44 ± 0.15 barns. The half life of Cs^{134m} is 2.895 ± 0.005 hr as determined from decay data obtained from a γ spectrometer and β-scintillation and proportional counters. (N.W.R.)

17579 CONVERSION COEFFICIENTS FOR THE 127 Kev TRANSITION IN THE DECAY OF ^{134m}Cs. B. Keisch and E. A. C. Yates (Phillips Petroleum Co., Idaho Falls, Idaho). J. Inorg. & Nuclear Chem., 17: 183-4(Apr. 1961). (In English)

Using a 4π β-γ coincidence counting technique, the dis/γ ratio was determined to be 7.0 ± 0.2. In the course of the work the K conversion coefficient was redetermined to be 2.60 ± 0.04, which agrees with previous data. From the data the sum L/K + M/K (ratios of numbers of L and M to K electrons emitted) was calculated to be 1.31 ± 0.05. (N.W.R.)

17580 PREPARATION OF LONG-LIVED HAFNIUM-182. R. A. Naumann (Frick Chemical and Palmer Physical Labs., Princeton, N. J.) and M. C. Michel. J. Inorg. & Nuclear Chem., 17: 189-90(Apr. 1961). (In English)

Hf^{182} was prepared by irradiating Hf for six months at a neutron flux of 3×10^{14} n/cm^2 per sec. The samples consisted of normal HfO_2, 10mg, and enriched HfO_2 (93.3% Hf^{180}), 16mg, in quartz ampoules. After irradiation, the samples were allowed to decay for 30 months. Then the ampoules were dissolved in HF and adjusted to 12N in H_2SO_4 and 0.4N in HF. Successive extractions of these solutions with methyl-isobutyl ketone were carried out until scintillation spectra of the organic fractions taken with a deep well crystal revealed no Ta^{182} activity. Then the enriched sample showed the presence of the Hf^{182} when investigated with the mass spectrometer. From the counting rate of Ta^{182} daughter, the saturation specific activity of 360 ± 180 dis/min per mg was computed. The half life of Hf^{182} was calculated to be $8 \pm 5 \times 10^6$ years. (N.W.R.)

17581 ANGULAR DISTRIBUTIONS OF PROTONS FROM THE ALPHA PARTICLE BOMBARDMENT OF B^{10}, N^{14}, O^{16}, AND Ne^{20}. Hisashi Yamaguchi (Tokyo Univ.). J. Phys. Soc. Japan, 16: 583-92(Apr. 1961). (In English)

Angular distributions of protons from alpha particle bombardment were obtained for the following transitions, corresponding to discrete states of the residual nuclei: $B^{10}(\alpha,p)C^{13}$ ground at bombarding energies 27.5 and 33.1 Mev; $N^{14}(\alpha,p)O^{17}$ ground, first, second, third at bombarding energies 26.8, 28.1, and 33.3 Mev; $O^{16}(\alpha,p)F^{19}$ ground to second (unresolved), third to fifth (unresolved), sixth at bombarding energies 26.7 and 33.1 Mev; and $Ne^{20}(\alpha,p)Na^{23}$ ground and first (unresolved), second to sixth (unresolved) at bombarding energy 26.9 Mev. These angular distributions show the so-called diffraction patterns and some of them are interpreted with the aid of predictions of the direct interaction theory. However, some deviations from the predictions of the direct interaction theory exist and suggest the effect of other nuclear reaction processes. (auth)

17582 RESONANCE LEVELS IN THE REACTIONS $^{28}Si(p,\gamma)^{29}P$, $^{29}Si(p,\gamma)^{30}P$ AND $^{30}Si(p,\gamma)^{31}P$. Haruko Ohmura, Hiroyasu Ejiri, Yutaka Nakajima, Kinuko Horie, Kiichi Etoh, Akiji Ohuchi, and Yozo Nogami (Tokyo Univ.). J. Phys. Soc. Japan, 16: 593-7(Apr. 1961). (In English)

The reactions $Si^{28}(p,\gamma)P^{29}$, $Si^{29}(p,\gamma)P^{30}$, and $Si^{30}(p,\gamma)P^{31}$ are studied in the region of proton energy from 300 to 1700 kev. Two new resonances were found in the reaction $Si^{29}(p,\gamma)P^{30}$ at proton energies 1307.5 ± 3 and 1331.5 ± 3 kev, and in the reaction $Si^{30}(p,\gamma)P^{31}$ nine new resonances were found at proton energies 1094, 1179.5, 1209.5, 1290.5, 1300, 1302.5, 1324.5, 1394.5, and 1403 kev with the errors of ±3 kev. No definite resonant level was observed in the reaction $Si^{28}(p,\gamma)P^{29}$ in the range of proton energy between 570 and 1400 kev. (auth)

17583 THE REACTION $Mg^{25}(d,p)Mg^{26}$ IN THE ENERGY RANGE OF DEUTERONS FROM 1.5 MeV TO 3.0 MeV. Naoyuki Takano (Kyusyu Univ., Fukuoka, Japan). J. Phys. Soc. Japan, 16: 598-604(Apr. 1961). (In English)

Angular distributions and excitation functions of protons from the reaction $Mg^{25}(d,p)Mg^{26}$, leading to the 1.83- and 2.97-Mev states of Mg^{26}, are investigated in the deuteron energy range from 1.55 to 3.00 Mev. The yield of protons leading to the ground state were so small that this group was not measured. The results of angular distributions were compared with the deuteron stripping theory, and a qualitative agreement for the second excited state group at deuteron energies above 2.5 Mev was obtained in the forward directions, but not for the first excited state group, and also in the backward directions for each group. The angular distributions of the first excited state group at deuteron energies above 2.44 Mev could be fitted to Bhatia's formula with two l_n-values of 0 and 2. Both angular distributions include a considerable isotropic part and show a competition between deuteron stripping and compound nucleus formation. Also, the results of excitation functions for the total cross section were compared with the statistical theory and a fairly good agreement was obtained with the interaction radius of $(1.21 + 1.3 \cdot A^{-1/3}) \times 10^{-13}$ cm. Furthermore, the small yield of this reaction seems to show that Coulomb effects play an important role in this lower energy range. (auth)

17584 DECAY OF Ir^{195} AND Ir^{197}. Saburo Homma (Tohoku Univ., Sendai, Japan), Tokihiro Kuroyanagi, and Haruhiko Morinaga. J. Phys. Soc. Japan, 16: 841-2(Apr. 1961). (In English)

The beta energies of Ir^{195} and Ir^{197} are compared with those predicted by beta-decay systematics. The beta energies 1 Mev and 0.6 Mev were found for Ir^{195}; no beta above 1 Mev with a half life of 2.3 hr was observed. 2.0 and 1.5 Mev beta rays were found and assigned to 7-min. Ir^{197}. The energies and relative intensities of gamma rays following the decays are also tabularly given. (N.W.R.)

17585 LINEAR POTENTIAL BARRIER MODEL FOR NUCLEAR SURFACE. Tutomu Inoue (Nagoya Technical Coll., Japan). J. Phys. Soc. Japan, 16: 844-5(Apr. 1961). (In English)

Sugiyama's calculation of the surface energy of the linear potential barrier $v(x) = -(h^2 k_F{}^3/2M)\cdot(x/x_0)$ for $x \leq 0$ is extended to a larger range of $k_F x_0$. For a diffused barrier, an approximate phase shift is calculated by the WKB method and the position of the effective surface is calculated by the Thomas-Fermi approximation. The two methods are then compared. From the data on surface coefficients it is shown that the reduction of Sugiyama's expressions to the Thomas-Fermi approximation is practicable not only in the case of the diffused linear barrier but for any diffused barrier, if the phase shift can be calculated by the WKB method. (N.W.R.)

17586 EXPERIMENTAL STUDIES OF U^{238} RESONANCE NEUTRON CAPTURE IN UO_2 FUEL RODS. G. G. Smith, J. Hardy, D. Klein, and J. A. Mitchell (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 9: 421-9 (Apr. 1961).

The relative U^{238} resonance capture integrals of 0.387 in. diameter UO_2 and uranium metal fuel rods are measured, as well as the spatial distributions of the captures in each type of rod. The effective resonance integral of the UO_2 rod is 1.30 ± 0.02 times that of the uranium metal rod. This difference is due to the lower density of uranium atoms and the presence of oxygen moderation in the UO_2 fuel rod. The relative importance of each of these two effects is determined by means of U–Zr and U–Al alloy fuel rods. Of the 0.30 excess of the UO_2 resonance capture integral over that of the uranium metal, 0.15 ± 0.02 is contributed by the lower U^{238} atom density of the UO_2 rod, and the remaining 0.15 is attributed to oxygen moderation. Discrepancies between previous results and these results can be attributed, at least partially, to differing flux spectra. There is an appreciable flux peak above 30 kev present in these measurements. (auth)

17587 THE TRANSURANIUM ELEMENTS. Glenn T. Seaborg (Univ. of California, Berkeley). Nuclear Sci. and Eng., 9: 475-87(Apr. 1961).

Production methods and chemical and nuclear techniques for identification of elements 99 through 102 (Es, Fm, Md, and No respectively) are reviewed. Heavy-ion bombardment is used to produce No. Nobelium and francium are separated from the target by a recoil process; Md is also isolated by this recoil technique. Problems in production of nuclei with even heavier atomic number (Z) are discussed, including scarcity of high-Z target materials, mainly Bk and Cf.Cf production programs are outlined. Use of heavy-ion bombardment to produce elements with $Z \geq 103$ is examined. (T.F.H.)

17588 EQUAL CHARGE DISPLACEMENT RULE IN FISSION PRODUCT POISONING. Melvin M. Levine (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 9: 495-9(Apr. 1961). (BNL-4877)

The equal charge displacement rule is used for estimating yields of some important fission products. The present method increases the reliability of previous estimates. Using recent yield values, thermal and resonance effects of gross fission products are calculated. (auth)

17589 THE RESONANCE INTEGRAL OF THORIUM METAL RODS. Eric Hellstrand and Jakob Weitman (Aktiebolaget Atomenergi, Stockholm). Nuclear Sci. and Eng., 9: 507-18(Apr. 1961).

The resonance integral (RI) for thorium rods of different diameters is determined by the activation method. The irradiations take place in a reactor channel where the energy dependence of the neutron flux is known up to several kev. The absolute calibration is made with gold as a standard. The true RI for gold is taken as 1500 ± 35 b. The experimental values for thorium are fitted to two alternative expressions, $RI = (1.70 + 15.9\sqrt{S/M}) \pm 5.5\%$, or $RI = 17.3\sqrt{S/M + 0.06} \pm 5.5\%$. Measurements are made for S/M values in the range 0.14 to 0.87 cm^2/g. The main contribution to the error arises from the uncertainties in the cross sections used and in the correction for the departure of the neutron energy distribution from the 1/E form. (auth)

17590 p-PROCESS AS A SOURCE OF BYPASSED NUCLIDES SYNTHESIS. M. Taube (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 821-30(1960). (In Russian)

The possible mechanisms and theories of a synthesis of 30 bypassed nuclides are analyzed. The p-process (fast proton radiation capture) is a source of the bypassed nuclides. The dependence of the function $\log N^A Z/N^{A-2}[Z-2]$ (where $^A Z$ – bypassed nuclide, N – cosmic abundance) on the Z value is calculated.

17591 THE GROUND STATE SPIN OF $^{212}_{84}Po$. F. Demichelis (Istituto di Fisica Sperimentale del Politecnico, Turin). Nuovo cimento (10), 19: 642-52(Feb. 16, 1961). (In English)

The angular correlation between the β transitions (energy 2.27 Mev) from the ground state of Bi^{212} to the ground state of Po^{212} and the α particles (energy 8.776 Mev) from the ground state of Po^{212} to the ground state of Pb^{208} was measured. The angular correlation between the γ rays (energy 0.727 Mev) from the first excited state to the ground state of Po^{212} and the above α particles was also measured. The very short lifetime of Po^{212} allowed these measurements. Isotropic correlations were found in opposition to previous experimental results. The results are in agreement with the J = 0+ assignment to the ground state of the even-even nucleus Po^{212}. (auth)

17592 RECOILLESS EMISSION AND ABSORPTION OF 26 keV γ-RAY OF ^{161}Dy. S. Jha, R. K. Gupta, H. G. Devare, G. C. Pramila, and R. Srinivasa Raghavan (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 19: 682-6(Feb. 16, 1961). (In English)

Recoilless emission and resonance absorption of the 26-kev γ ray emitted in the β decay of Tb^{161} were observed. The existence of the first excited state of Dy^{161} at 26 kev is thus confirmed. From the measurement of the transmission of this γ ray through various thicknesses of the Dy_2O_3 absorber, the percentages of recoilless emission and recoilless absorption were estimated to be (10 ± 2)% and (6.5 ± 2)%, respectively. From the curve showing the change in the transmission as a function of the relative velocity of the source and the absorber, the width of the 26-kev state (for an absorber thickness of 19.65 mg/cm^2) was found to be about 1.04×10^{-6} ev, which is about 70 times what is expected from the measured half life of this state. (auth)

17593 THE POPULATION RATIO OF THE 4.433 MeV AND 7.656 MeV STATES IN ^{12}C IN THE REACTION $^9Be(\alpha,n)^{12}C$, AND THE PARAMETERS OF THE 7.656 MeV LEVEL. N. H. Gale and J. B. Garg (The University, Manchester, Eng.). Nuovo cimento (10), 19: 742-51(Feb. 16, 1961). (In English)

A pulsed beam neutron time-of-flight spectrometer was used to study the reaction $Be^9(\alpha,n)C^{12*}$ at bombarding energies of 5.53, 5.76, and 5.97 Mev. Angular distributions of neutron groups leading to the ground state and first two ex-

cited states of C^{12} were measured, and the population ratio of the 4.433 and 7.656 Mev levels was established as 10.7 ± 0.8 at ~5.5 Mev. In conjunction with other evidence, the measured value of population ratio establishes the α particle decay width of the 7.656-Mev level as approximately the Wigner limit, the spin and parity as 0+, and allows estimates to be made of the probabilities of pair and γ decay of this state. (auth)

17594 NOTE ON THE POLARIZATION OF NUCLEONS SCATTERED FROM LIGHT NUCLEI. Y. Sakamoto (Kyoto Univ.). Nuovo cimento (10), 19: 835-6(Feb. 16, 1961). (In English)

For an incident energy of about 90 Mev, the experimental polarization of the proton scattered from He^4 differs from the one of C^{12} at forward small angles, though the calculated results by the use of the optical model potential predict the same polarization for all α particle type nuclei. In the angular region of interest the polarization of p-He^4 scattering is smaller than that of p-C^{12} at about 90 Mev, while the former is larger than the latter at about 150 Mev. The differences of the polarizations of the protons scattered from α particle type nuclei at about 150 Mev are mainly caused by the charge distributions of the target nuclei. The results for α particle type nuclei are compared with experimental data. The experimental values are measured at $\theta = 5°$, and the calculated results are evaluated by using the Gammel-Thaler phase shifts of two-nucleon scattering at 150 Mev. (N.W.R.)

17595 NUCLEAR RESONANCE FLUORESCENCE FROM THE 279-kev LEVEL OF Tl^{203} WITH AN ULTRACENTRIFUGE. B. I. Deutch and F. R. Metzger (Bartol Research Foundation, Swarthmore, Penna.). Phys. Rev., 122: 848-54(May 1, 1961).

Resonance fluorescence from the 279-kev level of Tl^{203} was studied with the centrifuge method. Assuming a total conversion coefficient $\alpha_T = 0.225$, a mean life $\tau_\gamma = (5.00 \pm 0.24) \times 10^{-10}$ sec for gamma-ray emission was calculated from the resonance scattering measured at different source velocities. Combining this lifetime with the B(E2) from Coulomb excitation, the absolute value of the mixing amplitude $\delta = (E2/M1)^{1/2}$ is $|\delta| = 1.31^{+0.24}_{-0.18}$. The angular distribution of the resonance radiation was found to be of the form $W(\theta) = 1 + (0.87 \pm 0.08)P_2(\cos\theta)$. This angular distribution, together with the range of absolute values of δ given above, fixes the sign of δ as positive. The range of δ values permitted by the angular distribution measurements is $\delta = +1.20^{+0.20}_{-0.12}$. (auth)

17596 LIFETIME OF THE 279-kev STATE OF Tl^{203}. A. Schwarzschild and J. V. Kane (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 122: 854-6(May 1, 1961). (BNL-5150)

The lifetime of the first excited state of Tl^{203} at 279 kev is measured using the delayed coincidence technique. From analysis of the exponential decay observed with an electronic time-to-pulse-height converter, the mean life was determined to be $(4.05 \pm 0.08) \times 10^{-10}$ sec. The decay of this state was observed using sources of Hg^{203} and Pb^{203}, both sources yielding the same mean life within statistical errors. This value of the lifetime agrees very well with the recent determination by Deutsch and Metzger utilizing the resonance fluorescence method. (auth)

17597 NUCLEAR INTERACTIONS IN DEUTERIUM FLUORIDE. H. Mark Nelson, John A. Leavitt, Milton R. Baker, and Norman F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev., 122: 856-9(May 1, 1961).

The deuteron and fluorine magnetic resonance spectra in the molecule DF were studied using the molecular beam method. The observed resonance patterns are compared with those calculated on a UNIVAC computer. The parameters of the calculation were adjusted until the theoretical and the experimental curves matched. In this manner the spin-rotational interaction constant of fluorine in DF was assigned the value $|c_F| = 160 \pm 1$ kc/sec and the quadrupole coupling constant of the deuteron in DF was assigned the value $|d_2| = 34 \pm 4$ kc/sec, which corresponds to $|eqQ/h| = 340 \pm 40$ kc/sec. (auth)

17598 NEW ISOTOPE OF MANGANESE; CROSS SECTIONS OF THE IRON ISOTOPES FOR 14.8-Mev NEUTRONS. D. M. Chittenden, II., D. G. Gardner, and R. W. Fink (Univ. of Arkansas, Fayetteville). Phys. Rev., 122: 860-1(May 1, 1961).

Bombardment of iron enriched in Fe^{58} with 14.8-Mev neutrons produces an activity having a half life of 1.1 ± 0.1 min. On the basis of cross bombardments and the gamma-ray spectrum of the activity, this is assigned to Mn^{58}. In addition, the following cross sections were measured: $Fe^{58}(n,p)$, 23.0 ± 3.5 mb; $Fe^{57}(n,p)$, 71.0 ± 7.0 mb; $Fe^{56}(n,p)$, 128 ± 13 mb; $Fe^{58}(n,\alpha)$, 21.5 ± 2.0 mb; $Fe^{54}(n,\alpha)$, 270 ± 135 mb; $Fe^{57}(n,np)$, 6.1 ± 2.6 mb; $Fe^{54}(n,2n)$, 7.9 ± 0.8 mb; $Fe^{54}(n,t)$, 0.6 ± 0.1 mb. (auth)

17599 (p,n) ANGULAR DISTRIBUTIONS FROM MIRROR NUCLEUS TARGETS: C^{13}, B^{11}, AND Be^9. R. D. Albert, S. D. Bloom, and N. K. Glendenning (Univ. of California, Livermore and Univ. of California, Berkeley). Phys. Rev., 122: 862-9(May 1, 1961). (UCRL-6199)

Neutron angular distributions from the (p,n) reactions in C^{13}, B^{11}, and Be^9 are measured using a long-counter detection technique in conjunction with the Livermore 90-inch variable-energy cyclotron. Proton energies ranged from threshold (2.0 Mev to 3.2 Mev) up to 5.7 Mev. The aim here was to find qualitative experimental evidence bearing on the direct reaction mechanism proposed by Bloom, Glendenning, and Moszkowski wherein the (p,n) reaction connecting the ground states of mirror nuclei should go via a direct mode which is derived principally from the residual two-body interaction between the incoming proton and the bound neutron (or neutrons). It is found that the experimental evidence supports this hypothesis in that the angular distribution changes slowly in the direction of increasing complexity with increasing energy, largely ignoring the occurrence of resonances except in their immediate vicinity. Also a tentative grouping by pairs of the (p,n) angular distributions for (C^{13}, N^{15}) and (Be^9, B^{11}) shows marked similarities between the members of each pair in conformity with the twin-reaction picture stemming from the same theory. The comparison between theory and experiment is in general encouraging. It is found that a triplet-singlet interaction strength ratio is required here which is about $\frac{2}{3}$ of that derived from the Gammel-Thaler phenomenological potential. However, in view of the basic differences between the free and the bound two-body problem it is felt that more knowledge will be required in order to properly compare the present results with the free-scattering analyses. (auth)

17600 $Si^{28}(d,p)Si^{29}$ REACTION. A. G. Blair and K. S. Quisenberry (Univ. of Pittsburgh). Phys. Rev., 122: 869-73(May 1, 1961).

The 15-Mev deuteron beam was used to study the $Si^{28}(d,p)Si^{29}$ reaction. Angular distributions of protons from most of the Si^{29} levels up to an excitation energy of 6.4 Mev were obtained. Good agreement with the 8-Mev deuteron results of Holt and Marsham (at a deuteron en-

ergy of 8 Mev) was found, except in a few cases where an l = 2 distribution showed low-angle peaking in one of the experiments but not in the other. The angular distributions of the 5.94- and 6.19-Mev states in Si^{29}, not previously reported, were obtained. Butler curves with l = 2 and l = 3, respectively, were fitted to these two distributions. A somewhat unusual evaporation technique used to prepare the necessary targets from small quantities of SiO_2 with relatively high collection efficiency is described. (auth)

17601 LOW-LYING ENERGY STATES IN Ne^{20} FROM THE $F^{19}(d,n)Ne^{20}$ REACTION. R. E. Benenson, H. Y. Chen, and L. J. Lidofsky (Columbia Univ., New York). Phys. Rev., 122: 874-8(May 1, 1961).

Six neutron groups from the $F^{19}(d,n)Ne^{20}$ reaction corresponding to the lowest states in Ne^{20} were observed at six angles of observation. The major part of the experiment employed nuclear emulsions and an average deuteron energy of 3.57 Mev. The importance of stripping appears to depend on the particular level involved; in particular, angular distributions leading to unambiguous assignments by stripping theory appear only for the ground, 1.63-Mev, and 6.75-Mev levels. The ground-state assignment appears to be energy dependent when the present $l_p = 2$ value is compared to the $l_p = 0$ value previously reported for a higher bombarding energy. The 4.25-Mev level in Ne^{20} gives rise to an angular distribution which could be either $l_p = 2$ or $l_p = 3$, but the fit to theory is not satisfactory for either case. A qualitative argument is given favoring the latter value. No assignment can be made to the 4.97- and 5.63-Mev levels. A brief second experiment with a fast neutron spectrometer was performed in order to obtain an absolute differential cross section at 0° for Ne^{20} left in its 6.75-Mev level. The reduced width obtained from this cross section is compared with a published reduced width for this same level obtained by elastic scattering of alpha particles by O^{16}. (auth)

17602 DECAY OF A NEW ISOTOPE, S^{30}. E. L. Robinson, J. I. Rhode, and O. E. Johnson (Purdue Univ., Lafayette, Ind.). Phys. Rev., 122: 879-84(May 1, 1961).

Scintillation techniques were used to study the beta and gamma radiation from high-purity natural silicon targets after irradiation with 8-Mev He^3 ions. In addition to activities associated with well-known radioisotopes, an activity with a (1.35 ± 0.10)-sec half-life was observed. A (677 ± 10)-kev gamma ray was associated with the 1.35-sec half-life. Decomposition of decay curves constructed from data obtained by observing annihilation radiation revealed a component with the same half life. Half-life measurements using positrons with energies in excess of 3.15 Mev also indicated the presence of a 1.35-sec activity. The beta spectrum in coincidence with two annihilation quanta extended to ≈5.0 Mev, a higher energy than can be accounted for by positrons from the known reaction products. The beta spectrum in coincidence with the (677 ± 10)-kev gamma ray had an end-point energy of (4.30 ± 0.15) Mev. The assignment of the (1.35 ± 0.10)-sec activity to the decay of S^{30} produced in the reaction $Si^{28}(He^3,n)S^{30}$, and the proposed decay scheme are supported by arguments formulated from the known characteristics of reaction products, half-life studies using both beta and gamma radiation, the features of the experimental beta and gamma spectra, beta-gamma coincidence spectra, nuclear systematics, and nuclear theory. The decay of the ground state of S^{30} takes place by at least two positron transitions: β_1, a (4.98 ± 0.15)-Mev superallowed transition to the 1+, T = 0 ground state of P^{30}; β_2, a (4.30 ± 0.15)-Mev superallowed transition to the 0+, T = 1 (0.677 ± 0.010)-Mev first excited state of P^{30}. No evidence was found for β_3, presumably an allowed transition to the 1+, (0.704 ± 0.005)-Mev second excited state of P^{30}, but an experimental upper limit of 25% is placed on its branching percentage. Branching percentages of (19 ± 2)%, (73 ± 7)%, and (8 ± 10)% for β_1, β_2, and β_3 were calculated using the measured S^{30} half-life, a $S^{30}-P^{30}$ mass difference of (6.01 ± 0.15) Mev, assumed charge independence of nuclear forces, and the fact that log ft for 0^+ to 0^+ positrons within T = 1 charge multiplets is almost constant. (auth)

17603 EXCITED STATES IN N^{14} FROM THE ELASTIC SCATTERING OF PROTONS BY C^{13}. E. Kashy, R. R. Perry, R. L. Steele, and J. R. Risser (Rice Univ., Houston, Tex.). Phys. Rev., 122: 884-90(May 1, 1961).

Excited states in N^{14} are observed by measuring the differential elastic scattering cross section of $C^{13}(p,p)C^{13}$ for proton energies from 2.6 to 5.0 Mev. Resonances were observed at proton energies of 2.743, 2.87, 3.105, 3.20, 3.78, 3.980, 4.04, and 4.14 Mev, corresponding to excited states in N^{14} at 10.092, 10.21, 10.428, 10.52, 11.05, 11.240, 11.30, and 11.39 Mev, respectively. Single-level dispersion theory analysis indicates assignments $J^\pi = 1^+$ (2^+), 1^-, 2^+, 1^-, 1^+, 3^-, 2^-, and 1^+, respectively, for these states. Analysis of previously published $C^{13}(p,p)C^{13}$ data at lower energies confirms the assignments 1^-, 0^+, 0^-, 3^-, and 1^+ for the states at 8.05, 8.61, 8.75, 8.90, and 8.98 Mev. A resonance at 4.265 Mev corresponding to the known narrow state at 11.504 Mev was not found in the elastic scattering data although it was found to be strong in $C^{13}(p,p')C^{13*}$. (auth)

17604 NUCLEAR SPIN AND MAGNETIC MOMENT OF 2.6-hr Mn^{56}. W. J. Childs, L. S. Goodman, and L. J. Kieffer (Argonne National Lab., Ill.). Phys. Rev., 122: 891-6(May 1, 1961).

The atomic-beam magnetic-resonance technique is used to examine the hyperfine structure of 2.6-hr Mn^{56}. The results obtained are I = 3, $|a| = 56.3924 \pm 0.0023$ Mc/sec, $|b| \leq 0.050$ Mc/sec, $g_j = 2.0012 \pm 0.0001$, and $\mu_I = +3.2402 \pm 0.0002$ nm. The value given for the nuclear magnetic dipole moment is deduced from the Fermi-Segrè relation and is therefore subject to correction for a possible hyperfine anomaly. (auth)

17605 LEVELS IN N^{14} AT 11.74 AND 11.82 MEV. J. K. Bair (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 897-9(May 1, 1961).

The known angular distribution of the $C^{13}(p,p'\gamma)C^{13}$ 3.68-Mev gamma rays is not sufficient to determine uniquely the spin and parity of the 11.74-Mev N^{14} level for the case of arbitrary channel-spin mixing. To resolve this ambiguity the angular distribution of the inelastic scattered protons is measured. Of the previous possibilities, $J^\pi = 1^+$, $2^\pm$, and 3^-, the assignment 1^+ is selected. A new level is found at 11.82 Mev in N^{14} having a width of about 100 kev, and decaying through the 3.09-Mev level in C^{13}. An angular distribution of the inelasticity scattered protons from this new level shows strong interference effects. (auth)

17606 DELAYED NEUTRONS FROM N^{17}. G. J. Perlow, W. J. Ramler, A. F. Stehney, and J. L. Yntema (Argonne National Lab., Ill.). Phys. Rev., 122: 899-901 (May 1, 1961).

The energies of the delayed neutrons which follow the decay of N^{17} are measured by means of a triple proportional-counter recoil spectrometer. The N^{17} was obtained from the $C^{14}(\alpha,p)N^{17}$ reaction at a mean α-particle energy of 25-Mev. Two neutron groups were observed, with en-

ergies of 1.22 ± 0.06 Mev and 0.426 ± 0.018 Mev. These correspond to neutron emission from the $^3/_2^-$ states of O^{17} at 5.38 and 4.55 Mev, respectively. This result is consistent with the expected J^π of $^1/_2^-$ for the ground state of N^{17} and with the small stripping widths for these levels in $O^{16}(d,p)O^{17}$. The ratio of the intensity of the high-energy group to the low-energy one is 1.6, which corresponds to a ratio of 4 for the squares of the β-decay matrix elements. (auth)

17607 CALCULATIONS IN NUCLEAR EVAPORATION THEORY. Richard Chasman (Argonne National Lab., Ill.). Phys. Rev., 122: 902-7(May 1, 1961).

Methods are developed for analytic treatment of problems in nuclear evaporation theory using the level density formula $\exp\{2[a(E^* - \epsilon)]^{1/2}\}$. Several useful expansions are given, with their ranges of validity. Comparisons made with existing calculations indicate the validity of this approach. (auth)

17608 GAMMA-RAY DE-EXCITATION OF THE LOW LEVELS OF F^{18}. J. A. Kuehner, E. Almqvist, and D. A. Bromley (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 122: 908-19(May 1, 1961).

The reaction $O^{16}(He^3,p)F^{18}$ is employed to study the de-excitation gamma-ray branching of levels in F^{18} up to about 3 Mev using $p\gamma$ coincidence techniques. These measurements are shown to be in reasonable agreement with tentative level identifications, 0 Mev (1+), 0.94 Mev (3+), 1.04 Mev (0+, T = 1), 1.12 Mev (5+), 1.70 Mev (1+), 2.10 Mev (2+), 2.53 Mev (3+), and 3.06 or 3.13 Mev unresolved (2+, T = 1), based on the intermediate-coupling shell-model predictions of Elliott and Flowers and of Redlich. An additional level at 1.08 Mev, which may arise from core excitation, is shown likely to have spin zero. It is suggested that the predicted energies need to be reduced by a factor of 0.6 and that the T = 1 levels require shifting with respect to the T = 0 levels to bring them into agreement with experiment. It is not found possible to obtain an adequate fit to the F^{18} level spectrum presented in terms of a rotational collective model. The data may, however, be qualitatively in accord with an alpha-N^{14} cluster model interpretation. An example of the isotopic spin selection rule inhibiting $\Delta T = 0$ M1 transitions in self-conjugate nuclei is found. (auth)

17609 EXCITED STATES IN P^{29} FROM THE SCATTERING OF PROTONS BY Si^{28}. T. A. Belote, E. Kashy, and J. R. Risser (Rice Univ., Houston, Tex.). Phys. Rev., 122: 920-8(May 1, 1961).

Excited states in P^{29} are observed by measuring the differential elastic scattering cross section of $Si^{28}(p,p)Si^{28}$ for proton energies from 2.0 to 5.0 Mev and the differential inelastic scattering cross section of $Si^{28}(p,p')Si^{28*}$ (Q = −1.78 Mev) for proton energies from 3.0 to 5.2 Mev. Resonances were observed at 2.080, 2.88, 3.095, 3.334, 3.571, 3.710, 3.98, 4.235, 4.36, 4.43, and 4.884 Mev, corresponding to excited states in P^{29} at 4.732, 5.50, 5.711, 5.942, 6.171, 6.305, 6.57, 6.812, 6.93, 7.00, and 7.438 Mev, respectively. Single-level dispersion theory analysis indicates assignments $J^\pi = {}^1/_2^+$, $^1/_2^-$, $^5/_2^-$, $^3/_2^+$, $^3/_2^-$, $^1/_2^-$, $^1/_2^+$, $^3/_2^+$, $^1/_2^+$, $^1/_2^-$, and $^5/_2^-$, respectively, for these states. (auth)

17610 FORMATION OF ALPHA CLUSTERS IN EVEN-EVEN NUCLEI. F. C. Chang (St. Johns Univ., Jamaica, N. Y.). Phys. Rev. Letters, 6: 414(Apr. 1961).

A study is made of α decay of even-even nuclei of mass number less than about 120, in which transition probabilities to the 0+ and 2+ states are of the same order and those to 4+ and higher states are much smaller. An attempt is made to explain the observed probabilities on the basis of probabilities of formation of α clusters of different angular momenta in the nuclear surface. (T.F.H.)

17611 MEASUREMENT OF THE RATE $\mu^- + C^{12} \rightarrow B^{12} + \nu$. E. J. Amier, B. L. Bloch, R. M. Edelstein, and R. T. Siegel (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. Letters, 6: 417-19(Apr. 15, 1961).

The μ^- meson absorption reaction $C^{12}(\mu^-,\nu)B^{12}$ is studied. A pulsed 45 Mev μ^- beam is absorbed in a plastic scintillant. Counters are arranged so the electrons produced in μ^- decay and in B^{12} β decay can be measured separately. The ratio of the total number of decay particles observed from the two decay processes, combined with the μ^- decay rate in C, yields the reaction rate. The presence of a weak magnetic effect in the interaction is discussed. (T.F.H.)

17612 HYPERFINE INTERACTIONS IN THE GROUND STATE AND FIRST EXCITED STATE OF Dy^{161} IN DYSPROSIUM IRON GARNET. R. Bauminger, S. G. Cohen, A. Marinov, and S. Ofer (Hebrew Univ., Jerusalem). Phys. Rev. Letters, 6: 467-70(May 1, 1961).

The hyperfine Zeeman splitting of the Mössbauer absorption spectrum in dysprosium iron garnet is studied. The Dy^{161m} 26 kev γ rays are absorbed at 85 and 300°K, and the relative absorption cross sections are measured for +12 to −12 cm/sec relative emitter-absorber velocity. The results are analyzed in terms of a $^5/_2$ spin first excited state with opposite magnetic moment to the ground state. A large observed temperature-dependent quadrupole effect is explained in terms of alignment of the 4f electrons below the Curie temperature. (T.F.H.)

17613 NEW ELEMENT, LAWRENCIUM, ATOMIC NUMBER 103. Albert Ghiorso, Torbjórn Sikkeland, Almon E. Larsh, and Robert M. Latimer (Univ. of California, Berkeley). Phys. Rev. Letters, 6: 473-5(May 1, 1961).

An element with atomic number 103 [suggested name Lawrencium (Lw)] is produced by bombardment of highly purified Cf (isotope nos. 249, 250, 251, and 252) with either B^{10} or B^{11}. Alpha particle emission energies of 8.6 Mev and an 8 ± 2-sec half life are attributed to the new element; it is thought that the mass number is 257. (T.F.H.)

17614 TWO-PHOTON DE-EXCITATION OF THE O+ LEVEL IN Zr^{90}. Hans Ryde, Pedro Thieberger, and Torsten Alväger (Nobel Inst. of Physics. Stockholm). Phys. Rev. Letters, 6: 475-8(May 1, 1961).

The transition from the 1.73 Mev O+ excited state of Zr^{90} to the O+ ground state is considered. Electromagnetic radiation is strongly forbidden, so that the only de-excitation modes are internal conversion, internal pair production, or $\gamma\gamma$ emission. The $\gamma\gamma$ emission is measured using coincidence techniques. The observed ratio of $\gamma\gamma$ emission to internal conversion is smaller than predicted theoretically; it is suggested that an intermediate level with an energy $\gg$1.73 Mev causes the low $\gamma\gamma$ emission probability (T.F.H.)

17615 THEORY OF SCATTERINGS AND REACTIONS. Yoshio Yamaguchi (CERN, Geneva). Progr. Theoret. Phys. (Kyoto), Suppl. No. 7, 1-34(1959). (In English)

Using the concepts of "eigen-phase shifts" and "eigen-channels", multichannel processes like nuclear reactions are discussed. A simple one-level formula is derived. The formulation of collision processes enables an explicit determination of the reaction amplitudes in cases where interference between resonance and potential scattering exists or two resonance levels are close together within their widths. Situations in which reactions via Bohr's "compound nucleus" occur are discussed. Finally, anomaly (e.g., "cusp" behavior) of the elastic scattering at the threshold, where a new channel becomes open, is considered. The

anomaly is demonstrated using a straight-forward generalization of Bethe's derivation of effective range theory. (auth)

17616 NUCLEAR MOMENTS AND CONFIGURATION MIXING. Hiroshi Noya (Tokyo Inst. of Tech.), Akito Arima, and Hisashi Horie. Progr. Theoret. Phys. (Kyoto), Suppl. No. 8, 34-112(1958). (In English)

The nuclear static moments are calculated from configuration mixing in the jj-coupling shell model. The residual interactions between particles in different orbits are taken as the cause of the configuration mixing. The single-particle energy differences in the energy denominators are estimated from a shell model Hamiltonian which gives fairly good agreement with observed single-particle levels, and the denominators contain the pairing effects in the zeroth order states. Various features of the deviations of magnetic dipole moments from the Schmidt lines are well interpreted by the configuration mixing for almost the whole region of nuclei. The quadrupole moment of an odd-neutron nucleus can be accounted for from the mixing of excited states of the ground configuration and of higher configurations of even numbers of protons. For those of odd-proton nuclei, the corrections by the similar mixing are almost as large as the single-proton values so that the quadrupole moments of the medium-weight nuclei which are two to three times as large as the single-proton values can be explained. However, the large quadrupole moments of the heavy nuclei cannot be interpreted by the perturbational treatment of configuration mixing. The corrections to the magnetic dipole moments of odd-odd nuclei are also calculated and good agreement with observed values is obtained. The magnetic octupole moments of odd-A nuclei are also considered on the same basis. The numerical results are not sensitive to the choice of the single-particle wave functions, as far as the harmonic oscillator and the square well wave functions are employed. The second order effects are estimated by calculating the mixing probabilities of excited configurations into the ground state for S^{33}, and the treatment by the first order perturbation theory appears justified at least for the medium-weight nuclei. Interactions with finite ranges are also considered and it is shown that, if a suitable exchange character is adopted for the interactions, the results are not much different from those by the delta-function interactions. (auth)

17617 YIELD OF ARGON ISOTOPES FROM TARGETS BOMBARDED BY 660 Mev PROTONS. E. K. Gerling and L. K. Levskii. Radiokhimiya, 3: No. 1, 97-100(1961). (In Russian)

The yields of Ar^{36}, Ar^{38}, and Ar^{39} were determined by measuring the isotopic content of argon separated from chemically different targets bombarded by 660 Mev protons. The derived ratio Ar^{38}/Ar^{39} was used for estimating the age of meteorites. It was found that the large portion of Ar^{36} found in meteorites is produced by the decay of long-life Cl^{36}. An empirical formula was selected for combining the values of argon formation cross sections. It is shown that argon isotope formation cross sections (within the order of error) do not depend on the chemical composition of the target. (R.V.J.)

17618 ON THE PAIRING ENERGY OF MEDIUM HEAVY NUCLEI. H. Kümmel (Max-Planck-Institut fur Chemie (Otto-Hahn-Institut), Mainz). Z. Naturforsch., 208-9(Feb. 1961). (In English)

The pairing energy was evaluated for all nuclei with neutron number $82 \leq N \leq 126$ where the experimental deformation parameters were known. The isotopic shift measurements were used to estimate deformation parameters, and the pairing energy was calculated. A comparison is made between the experimental and theoretical values. There is good agreement between the two values in spite of the crude approximations used. It is suggested that the single points which do not fit can be explained on the assumption that nuclei with too large or small experimental pairing energies have anomalously small or large deformations. (J.S.R.)

17619 DOUBLE ISOMERISM IN Ir^{194}. K. F. Alexander and H. F. Brinckmann (Zentralinstitut für Kernphysik, Rossendorf bei Dresden, Ger.). Z. Naturforsch., 16a: 210(Feb. 1961). (In German)

In addition to the 19-hr ground state of Ir^{194}, two short-lived isomeric states (one with a half life of 47 sec and the other with a half life of 50 msec) were detected. The results of very accurate measurements of these isomeric states are reported. Pulse activation with slow neutrons was the method used. The delayed spectrum recorded has a very strong line at 67 ± 5 kev and a much weaker line at 115 ± 10 kev. Decay measurements made on both lines gave, in agreement, a half life of 32 ± 2 msec. When the 115-kev line was correlated to the isomeric transition and the 67-kev line to the x radiation arising in the K conversion of the transition, $\alpha_K = 9$ was obtained as conversion coefficient. Other interpretations on the basis of these results are not excluded. (J.S.R.)

17620 THE SPIN OF THE GROUND STATE OF F^{20}. Ernst Freiberg and Volker Soergel (Universität, Freiburg i. B.). Z. Physik, 162: 114-18(1961). (In German)

The spin of the F^{20} ground state was determined by means of a circular polarization correlation measurement on the β-γ cascade of F^{20}. The experimental result gives spin 2 for the ground state of F^{20}. Within the statistical error of the experiment, the β decay of F^{20} has pure Gamow-Teller interaction. (auth)

17621 BETA AND GAMMA EMISSION FROM ORIENTED NUCLEI. Hans Postma. Thesis, Groningen, Netherlands, Rijksuniversiteit, 1960. 126p.

A study of β and γ emission from cryogenically oriented paramagnetic nuclei is presented. Investigations are made of the β^+ emission of Co^{58} and Mr^{52}, the β^- and γ emissions of Ho^{166m}, and the β^- emissions of Tb^{160}. The cryogenic methods and apparatus are described. (T.F.H.)

17622 FISSION AND FISSION PRODUCTS. G. N. Walton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.3-98 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

The history of the discovery of fission products is reviewed briefly. Topics discussed include the cause of the fission process; the different types of fission, including high-energy fission, ternary fission, fragmentation, and spallation; the formation of fission neutrons; fission energy; distribution in mass; the distribution of charge in fission; fission product chains; the radioactivity of fission products, including γ transitions and decay schemes; calculations of amounts of fission products formed in reactors; and fission product poisoning of reactors. 39 references. (C.H.)

17623 1960 NUCLEAR DATA TABLES. PART 1. CONSISTENT SET OF ENERGIES LIBERATED IN NUCLEAR REACTIONS. I. Targets in the Mass Region $A \leq 66$. F. Everling, L. A. Koenig, J. H. E. Mattauch, and A. H. Wapstra—K. Way, ed. (National Research Council. Nuclear Data Group). Feb. 1961. 214p.

A consistent set of energies liberated in nuclear reactions from targets in the mass region $A \leq 66$ is given. Re-

action Q-values were computed for the 214 nuclides from masses obtained from a new least-squares adjustment based on the most accurate experimental results of nuclear reaction work, β disintegration, and mass spectrographic studies. The incident particles treated are: γ, n, p, d, t, He^3, and α. The outgoing particles considered are: γ, n, p, d, t, He^3, α, 2n, n + p, and 2p. (M.C.G.)

17624 1960 NUCLEAR DATA TABLES. PART 2. CONSISTENT SET OF ENERGIES LIBERATED IN NUCLEAR REACTIONS. I. Targets in the Mass Region $67 \leq A \leq 199$. L. A. Koenig, J. H. E. Mattauch, and A. H. Wapstra—K. Way, ed. (National Research Council. Nuclear Data Group). Feb. 1961. 167p.

A table of adjusted q-values for targets in the mass region $67 \leq A \leq 199$ is presented. The least squares adjusted mass values were used for computation of these energies. Incident particles considered are: γ, n, p, d, t, He^3, and α. Outgoing particles included γ, n, p, d, t, He^3, α, 2n, n + p, and 2p. (M.C.G.)

Particle Accelerators

17625 (BNL-4925) PROPERTIES OF RF SWEEPING SYSTEM EMPLOYING A SLANTED TARGET AND PRE-SWEEPING FOCUSING. John V. Kane (Brookhaven National Lab., Upton, N. Y.). July 27, 1960. 13p.

It is shown that techniques combining target orientation with focusing lens permit production of bursts of radiation from targets having time durations in the 10^{-10} sec region. Applications to Van de Graaff positive ion beams in the Mev energy region are discussed. (D.L.C.)

17626 (CERN-61-7) A DIRECTIVE DEVICE FOR CHARGED PARTICLES AND ITS USE IN AN ENHANCED NEUTRINO BEAM. S. van der Meer (European Organization for Nuclear Research, Geneva). Feb. 27, 1961. 20p.

It was found that divergent beams of charged particles can be made nearly parallel by a magnetic horn that is analogous to an internally reflecting conical surface in geometrical optics. Trajectory calculations showed that it would accept a strongly divergent beam of charged particles over a wide momentum range. The current and power necessary for excitation indicate that the design must include pulsed operation. Data are presented for a horn designed for increasing the intensity of a neutrino beam. It would concentrate mesons (π) from an external target in the direction of the detectors. It was shown that this device would accept nearly all pions of one sign produced in the target. It was calculated that with this horn the neutrino interaction rate could be increased by an order of magnitude. (auth)

17627 (INS-TH-19) EFFECTS OF THE SECTOR-END FRINGING FIELD AND THE TRANSITIONAL FIELD IN THE A.G. SYNCHROTRON. Yoshiyuki Kobayashi (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1957. 13p.

In an alternating-gradient synchrotron, the actual magnetic field differs from the ideal one due to sector end fringing fields and transitional fields between positive and negative gradient sectors. The effects of the fringing field on the focusing property are calculated. It is concluded that for stability of betatron oscillation, the field distribution in the sector end and transitional regions need only be such as to make $(\partial \int_0^{s_0} B_z ds)/\partial x$ radially constant throughout the inside of the vacuum chamber to avoid harmful nonlinearities of n values. (D.L.C.)

17628 (INS-TH-20) DETAILED STABILITY PATTERN ABOUT OPERATION POINT. Yoshiyuki Kobayashi and Hiroshi Sasaki (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1957. 5p.

The stability pattern about the operation point $\pi_z = \pi_r = 4.5\pi$ is given for a particular sector arrangement of the octant lattice of an alternating synchrotron. When $\epsilon_1 = \epsilon_2 = 0$, $n_1 = 15.08$ and $n_2 = 14.97$ are obtained. A diagram of betatron phase shifts is given for variable values of ϵ_1 and ϵ_2. (D.L.C.)

17629 (INS-TH-24) EXPERIMENTS ON MODEL MAGNETS FOR 1-BEV ELECTRON SYNCHROTRON. PART I. Hiroo Kumagai, Seitaro Yamaguchi, Yoshiyuki Kobayashi, Hiroshi Sasaki, and Ryuji Yamada (Tokyo Univ. Inst. for Nuclear Study). Sept. 10, 1957. 12p.

The construction of Model II, an a-c $\frac{1}{2}$-scale magnet, is described. Three a-c measurements on the model were performed to obtain information for the design of the final magnet. The measurements were made for: the flux in an iron plate placed on the magnet with iron and wood spacers, to estimate the loss in the iron base of the final magnet; the effects of copper strips on the phase lag of the field, to determine the size and location of the exciting coil for the magnet; and the relative values of phase lag in the radial direction of the gap, to obtain information about the necessity of using pole face windings or other devices. (B.O.G.)

17630 (INS-TH-25) EXPERIMENTS ON MODEL MAGNETS FOR 1-BEV ELECTRON SYNCHROTRON. PART II. Hiroo Kumagai, Seitaro Yamaguchi, Yoshiyuki Kobayashi, Hiroshi Sasaki, and Ryuji Yamada (Tokyo Univ. Inst. for Nuclear Study). Sept. 16, 1957. 40p.

A description is given of the construction and parameters of Model I, a d-c $\frac{1}{2}$ scale magnet. The designs of the pole pieces and yoke shapes are discussed. Experiments conducted on the model consisted of determining leakage factors, flux distributions in the yoke, excitation curves, field distributions and n-values in the positive and negative sectors, remnant fields, shimming and momentum shaping, sector end fringing fields, transitional field distributions, forces acting on a pole piece, and the influence of a slit between the pole piece and yoke on the field flux. (B.O.G.)

17631 (NP-10006) BREMSSTRAHLUNG CONVERTER CONSIDERATIONS. Technical Report No. 22 (Supplement to Technical Report No. 21). P. Axel (Illinois. Univ., Urbana. Physics Research Lab.). Mar. 1961. Contract Nonr-1834(05). 30p.

The choice of proper bremsstrahlung target thickness and material depends on the experimental use and on background. Factors for use in choosing such targets are discussed, including low-high-Z materials, and the thickness parameters, background, resolution, and counting rate. (J.R.D.)

17632 (NP-10019) THE NORDIC-DUTCH SYMPOSIUM ON ACCELERATOR PHYSICS, [HELD] AT FISKEBACKSKIL, SWEDEN, AUGUST 15—AUGUST 23, 1959. (Sweden. Kungliga Vetenskapsakademien. Nobelinstitutet för Fysik, Stockholm). 91p.

Information presented at the symposium on accelerators was given in several group reports in which the activities at universities and other facilities were outlined. Lectures by individuals are included on aspects of nuclear scattering, capture, theory, and nuclear direct reactions. Other lectures were given on cyclotron development, and fast neutron cross section measurements and research. (J.R.D.)

17633 (NP-10120) CONSTRUCTION AND OPERATION OF BETATRON & CLOUD CHAMBER (thesis). Adriaan van der Woude (Groningen, Netherlands. Rijksuniversiteit). 1960. 113p.

Equipment used for the production and observation of electron-positron pairs created by γ rays in the gas of a cloud chamber is described. The gamma rays originate from a small 7 Mev betatron; construction and operational details are presented. The expansion cloud chamber, constructed for application of the overcompression technique, along with its auxiliary equipment is also described. A study of the thermal properties of the overcompression cloud chamber is given. Finally a short description of the experimental arrangement for the production of electron-positron pairs is given. (N.W.R.)

17634 (TID-12495) PRODUCTION OF HIGH INTENSITY ION PULSES OF NANOSECOND DURATION. L. Cranberg (Los Alamos Scientific Lab., N. Mex.), R. A. Fernald and F. S. Hahn (High Voltage Engineering Corp., Burlington, Mass.), and E. F. Shrader (Case Inst. of Tech., Cleveland). [1961]. 19p.

A system for producing high-intensity ion bursts of nanosecond duration is described. It consists of a Van de Graaff accelerator fitted with a deflection pulser in the terminal and a post-acceleration Mobley magnet with a bunching factor of about 12. Results are given on the overall performance at 3-Mev proton energy, observing the neutrons and gamma rays from the reaction $Mn^{55}(p,n)Fe^{55}$. The system performs in accordance with design expectations and delivers ion bursts of less than 1 nanosecond duration at a peak current of several milliamperes. (auth)

17635 (TID-12503) LINEAR ELECTRON ACCELERATOR STUDIES AND PROPOSED TWO-MILE ACCELERATOR PROJECT. Combined Status Report, October 1 to December 31, 1960. (Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Jan. 1961. Contracts AT(04-3)-21 and AT(04-3)-363. 48p. (ML-785; M-246)

Part of the planned conversion of Mark IV to a model section of the proposed two-mile accelerator was completed. It is shown that r-f heating of water jacket test sections driven by cw power is equivalent to that caused by pulsed power at the same average power level. The radial expansion of electrons in a uniform waveguide buncher was analyzed, and it is concluded that, in the worst case, the diameter of a beam entering the buncher parallel to the axis would be multiplied by 3 or less at the output end of the buncher. The performance of klystrons with Mark IV was studied. The results of window tests made on the recirculator are summarized. In the modulator studies, the a-c diode-charging circuit was found to be inferior to the d-c resonant-charging circuit, and a modified DQ-ing circuit was shown to be capable of providing economical voltage adjustment and regulation. Analysis of the accelerator beam parameters and the component tolerances show that the effect of random phase errors can be limited to reduction of the total beam energy, keeping the energy spectrum width constant. Equations are given expressing the spectrum width in terms of the net phase error. The results of cold tests conducted in the design of a constant-gradient accelerator structure are given. The results of space-harmonic-amplitude measurements made using two methods are also given. Tests of voltage-control range indicating too-small voltage control on the Project M modulator power supply model are reported. (D.L.C.)

17636 PRODUCTION OF SINGLE-ENERGY BEAMS OF ACCELERATED PARTICLES. F. R. Arutyunyan and I. P. Karabekov. Atomnaya Energ., 10: 259-60(Mar. 1961). (In Russian)

The production of monoenergetic pulsed beams (energy straggling less than 10^{-4}) with sufficiently large feeding circuit oscillations is described. A high-voltage transformer or transformer cascade is used as an acceleration source. A complete time diagram of pulses and intensities acting in the system is included. (R.V.J.)

17637 THE EFFECT OF THE TARGET DENSITY ON THE SPECTRAL DISTRIBUTION OF THE BREMSSTRAHLUNG OF A BETATRON. Gerhard Luck (Friedrich-Schiller-Universität, Jena, Ger.). Z. angew. Phys., 13: 105-8(Mar. 1961). (In German)

The energy distribution of the bremsstrahlung of finite thickness targets shows the expected shift of intensities from the short-wave to the long-wave part of the spectrum. Essentially, targets of the third Lawson thickness range were measured. This is the important range for the practical operation of a betatron. The total intensity of the bremsstrahlung as a function of angular position shows a distinct asymmetrical distribution, especially for greater target densities. In the weakly relativistic range investigated, this asymmetry is easily detected. To aid in determining the best proportion of a target for practical operation, a study was made to improve the detection of the radiation degree of an accelerator. In place of the integral dose output measurement, the bremsstrahlung spectrum measured as a function of various target thicknesses would be better. (tr-auth)

17638 METHOD AND APPARATUS FOR PULSING A CHARGED PARTICLE BEAM. K. Aaland, R. W. Kuenning, and R. K. Harmon (to U. S. Atomic Energy Commission). U. S. Patent 2,982,917. May 2, 1961.

A system is offered for pulsing a continuous beam of charged particles to form beam pulses that are consistently rectangular and of precise time durations which may be varied over an extremely wide range at a widely variable range of repetition rates. The system generally comprises spaced deflection plates on opposite sides of a beam axis in between which a unidirectional bias field is established to deflect the beam for impingement on an off-axis collector. The bias field is periodically neutralized by the application of fast rise time substantially rectangular pulses to one of the deflection plates in opposition to the bias field and then after a time delay to the other deflection plate in aiding relation to the bias field and during the flat crest portion of the bias opposing pulses. The voltage distribution of the resulting deflection field then includes neutral or zero portions which are of symmetrical substantially rectangular configuration relative to time and during which the beam axially passes the collector in the form of a substantially rectangular beam pulse.

Plasma Physics and Thermonuclear Processes

17639 (AD-245542) TRANSIENT CHARACTERISTICS OF A ROTATING PLASMA. Technical Release No. 34-122. Ching-Sheng Wu (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Oct. 14, 1960. Contract NASw-6. 19p.

A discussion is given of a method for obtaining a transient solution of the velocity distributions in a rotating plasma so that the time interval required to reach the stationary state may be estimated. Results are given for calculations of velocity distribution, total kinetic energy, and total viscous dissipation per unit length of the cylindrical space for three separate cases. (B.O.G.)

17640 (AERE-R-3611) LANGMUIR PROBE TECHNIQUES IN INTENSE DISCHARGES. H. W. Jones and P. A. H. Saunders (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1961. 33p.

The theory, techniques, and limitations of the use of Langmuir probes for exploring the characteristics of gas discharges are described. Probes in plasmas with and without magnetic fields, electron energy distribution, and electric field measurements are included. Experimental details are given for the investigation of pulsed discharges, including the construction of probes and their circuitry. (D.L.C.)

17641 (AERE-R-3643) CYLINDRICALLY SYMMETRICAL HYDROMAGNETIC DISTURBANCES IN A PLASMA. J. H. Adlam, I. C. Pyle (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England), and K. Hain (Max-Planck-Institut für Physik and Astrophysik, Munich). Jan. 1961. 30p.

Equations are derived which govern the motion of a cylinder of plasma under conditions such that collisions can be neglected. Numerical calculations are made for the compression of a plasma by a rapidly rising external magnetic field. (auth)

17642 (AFCRL-TN-60-971) ELECTRON AND PLASMA BEAM DYNAMICS. Scientific Report No. 8 (Interim Annual Report, 1959-60). D. H. Sloan, Charles Susskind, A. S. Trivelpiece, and J. R. Woodyard (California. Univ., Berkeley. Electronics Research Lab.). June 15, 1960. Contract AF19(604)-2270. 57p. (AD/245668).

A summary is presented of work done on electron optics and display devices, cross-field gaseous tubes, plasma studies, semiconductor properties of ionized gases, and interactions between electron beams and plasmas. (B.O.G.)

17643 (AFOSR-423) THE EFFECT OF COLLISIONS ON TWO-STREAM INSTABILITIES IN A PLASMA. Technical Note BN-234. D. A. Tidman and George H. Weiss (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Mar. 1961. Contract AF18-(600)1315. 28p.

A system is considered in which electrons pass at high speed through ion backgrounds resulting in a bunching mechanism and amplification of perturbations in the charge density of either component. The effects of a small amount of two-body scattering on such instability are examined. (J.R.D.)

17644 (AFOSR-542) THE WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA. PART III. WITH A TRANSVERSE APPLIED MAGNETIC FIELD. S. I. Pai (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Mar. 1961. Contract AF49(638)-401. 34p. (BN-235)

Wave motions of infinitesimal amplitude in a fully ionized plasma under a uniform transverse magnetic field have been analyzed by means of a two-fluid theory. One basic transverse wave and two basic logitudinal waves, as they were found for the case without external magnetic field, appear to interact with one another through the influence of this applied magnetic field and there are three resultant waves. In an ideal plasma, in the low frequency range, only one of the three resultant waves is undamped. When the ion cyclotron frequency is much smaller than the ion plasma frequency, this undamped wave reduces to the effective sound wave of ordinary magneto-gasdynamics. If the ion cyclotron frequency is not small, the speed of propagation of this wave is larger than the effective sound speed of magneto-gasdynamics. On the very high frequency range, all the three waves are undamped. In a certain intermediate frequency range two of the waves are undamped. The effects of finite electrical conductivity on these waves are briefly discussed. (auth)

17645 (EFINS-61-9) THE DISTRIBUTION OF TRAPPED PARTICLES IN A CHANGING MAGNETIC FIELD. E. N. Parker (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Feb. 1961. Contract AF18(600)-666. 37p. (AFOSR-402)

The redistribution of charged particles in the mirror field $B(s,t) = B_0\ T(t)\{1 + [s/a(t)]^{\nu(t)}\}$ is worked out for slow changes in T(t), a(t), and $\nu(t)$. It is found that increasing T(t) gives a relatively greater particle density increase in the center of the field than deep in the mirrors $s \gg a(t)$. The mirror distance retracts like $1/T^{1/(\nu+2)}$. Decreasing a(t) has the opposite effect. Field variations constrained to preserve $T(t)\ a^2(t)$ and $\nu(t)$ leave the form of the particle distribution unchanged, increasing the density everywhere by the same factor. Comparing the theoretical results with the analysis by Fan, Meyer, and Simpson (1961) of the large changes in the outer Van Allen radiation zone during the magnetic activity of August 1960 shows that the changes in the particle density can be explained by a small increase of T(t) with a(t) fixed, and later by a decrease of a(t) so that $T(t)\ a^2(t)$ approximates to its initial value. No irreversible particle injection or acceleration appears necessary to explain the changes in the radiation zone. (auth)

17646 (JAERI-4015) NUCLEAR FUSION RESEARCH COMMITTEE'S REPORT. Survey Report No. 15. (Japan Atomic Energy Research Inst., Tokyo). Nov. 1959. 47p.

The Nuclear Fusion Committee, organized in March 1959, proposed two plans for furthering studies on this field in Japan: the first of these outlines the theoretical approach while the second one sets as its goal the construction of a medium-size device for producing plasma temperatures of the order of about 10^6 °K, maintaining it for about 10^{-4} seconds. The detailed design of this machine, including the time schedule, manpower requirements, cost, technological problems and the needed instrumentation, is given in this report. The characteristics of the Stellarator, the DCX and of the ion cyclotron resonance type machines are also reviewed. It is concluded that the choice of the most promising machine for producing extremely high-temperature plasma is a difficult problem. These difficulties include the still-unexplained phenomenon of "pumpout" of the Stellarator and the meaning of the term "burnout" for the DCX. The ion cyclotron resonance mirror type machine has originally been designed in Japan and it is recommended to start a small-scale effort in this direction. The Hitachi group has already started construction of a similar machine. (TTT)

17647 (NYO-9491) THE BOUNDARY LAYER BETWEEN A PLASMA AND A MAGNETIC FIELD. [PART] I. Harold Grad (New York Univ., New York. Inst. of Mathematical Sciences). Dec. 28, 1960. Contract AT(30-1)-1480. 33p. (MF-12)

The problem of a steady boundary layer or sheath between a plasma and a magnetic field is considered. A self-consistent transition layer is found which joins a uniform magnetic field at plus infinity with a collisionless field-free plasma region with arbitrary velocity distribution at minus infinity, i.e., a magnetic field profile is found such that the exact particle orbits in this field produce a current which gives rise to this field. An interesting feature of the solution is that, with any nonsingular velocity distribution at minus infinity, the magnetic field

penetrates only a finite distance into the plasma, although the plasma extends to infinity, exponentially attenuated, into the magnetic field region. The scale of length is the Larmor radius. Electric fields arising from charge separation in the case of particles of different mass are ignored. (auth)

17648 (NYO-9492) THE EFFECT OF TEMPERATURE ON THE WIDTH OF A SMALL-AMPLITUDE, SOLITARY WAVE IN A COLLISION-FREE PLASMA. C. S. Gardner and G. K. Morikawa (New York Univ., New York. Inst. of Mathematical Sciences). Mar. 15, 1961. Contract AT(30-1)-1480. 28p. (MF-13)

The effect of finite plasma temperature on the solitary wave solution was investigated in the limiting case where the amplitude of the wave is very small and consequently the width of the wave is very large. It was found that in a warm plasma the solitary wave of small amplitude has the same form as in a cold plasma, but has a width that is larger than its width in a cold plasma by a factor which is approximately $\sqrt{1 + 1/16\ (m+/m-)\beta}$. In this factor β is the ratio of material pressure to magnetic pressure in the undisturbed plasma and m+, m− are the respective masses of a positive ion and of an electron. It was concluded that this factor is appreciable unless β is very small. (auth)

17649 (TIL/BIB/45) BIBLIOGRAPHY ON MAGNETO HYDRODYNAMICS, INCLUDING PLASMAS. (Gt. Brit. Ministry of Aviation. Technical Information and Library Services). Sept. 1960. 38p. (AD-245267).

The bibliography consists of 368 references to magnetohydrodynamics and plasmas published since 1943. The references are arranged chronologically. An author index is included. (B.O.G.)

17650 NECESSARY STABILITY CRITERIA FOR A HYDROMAGNETIC TOROIDAL SYSTEM IN SCALAR PRESSURE. Claude Mercier. Compt. rend., 252: 1577-8(Mar. 13, 1961). (In French)

Stability criteria for hydromagnetic toroidal systems in scalar pressure are established. The criteria come from the study of localized displacements in the vicinity of surfaces at constant pressure on which the magnetic lines are not ergodic. (tr-auth)

17651 SELF-MODELING SOLUTIONS OF THE EQUATIONS OF A LAMINAR BOUNDARY LAYER IN MAGNETOHYDRODYNAMICS. N. I. Pol'skii and I. T. Shvets (Inst. of Heat and Power Engineering, Academy of Sciences, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R., 136: 1051-4 (Feb. 11, 1961). (In Russian)

The laminar flow of a viscous liquid or gas with a constant electrical conductivity σ in the presence of a magnetic field is investigated mathematically. Solutions are obtained for an incompressible liquid in terms of dimensionless ratios for a variable magnetic field strength both along a body and normal to it. Analogous results can also be obtained for a compressible liquid. (TTT)

17652 LOW-INDUCTANCE CAPACITOR BANKS AND LINEAR PINCHED DISCHARGES. A. H. Gabriel, V. T. S. Howell, E. Thornton, and R. J. Wilson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 38: 136-42(Apr. 1961).

Details are given of low inductance capacitors, and capacitor banks with energy storages in the range 1 to 10 kj capable of giving maximum currents of 1.2 ma and rates of rise of 6×10^{12} a/s. The working voltage in the work described is 10 kv, but the techniques are used at higher voltages, up to 40 kv. An outline of the measurement techniques, used in the study of linear pinched discharges in low-pressure deuterium with these banks, is given. (auth)

17653 ENERGETIC PARAMETERS OF HIGH FREQUENCY DISCHARGE IN HYDROGEN. Stefan Chwaszczewski (Inst. of Nuclear Research, Warsaw). Nukleonika, 5: 863-74(1960). (In Polish)

The electric power necessary for supporting without electrode discharge in hydrogen excited by high frequency magnetic field, depending on amplitude of oscillating field and hydrogen pressure, is measured. The measurements were carried on for three different frequencies of exciting field, i.e., 15, 20, and 25 Mc/s. (auth)

17654 INCOHERENT MICROWAVE RADIATION FROM A PLASMA IN A MAGNETIC FIELD. Jay L. Hirshfield and Sanborn C. Brown (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 122: 719-25(May 1, 1961).

The microwave emission from a plasma in a magnetic field is calculated theoretically using Kirchhoff's radiation law for cases when characteristic waves do not couple within the plasma. Experimental observations of radiation temperatures and cyclotron radiation line breadth and shape are cited to illustrate applications of the theory to experiment. (auth)

17655 "CORKSCREW"—A DEVICE FOR CHANGING THE MAGNETIC MOMENT OF CHARGED PARTICLES IN A MAGNETIC FIELD. Richard C. Wingerson (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 6: 446-8(May 1, 1961).

A helical, current-carrying magnetic field source (the "corkscrew") is described; it perturbs an axial uniform magnetic field B_0 such that the transverse energy components (E_T) of selected particles moving along the axis are increased or decreased monotonically. It is noted that, since the corkscrew has no over-all effect on B_0, the change in E_T must result from a change in the particle's magnetic moment. The use of pairs of these devices in magnetic mirror machines to trap particles is suggested. (T.F.H.)

17656 PROCEEDINGS OF THE 1959 INTERNATIONAL PLASMA PHYSICS INSTITUTE. James E. Drummond, ed. (Boeing Scientific Research Labs., Seattle). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 1-240(Jan. 1961).

Thirty four papers are presented that were given at the International Plasma Physics Institute, held Aug. 31 to Sept. 5, 1959, in Seattle, Wash. The subject matter includes quantum and classical plasma physics, and thermodynamical and statistical approaches to plasma physics. Of the 34 papers, 27 are abstracted. (T.F.H.)

17657 CLASSICAL AND QUANTUM PLASMAS. D. Pines (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 5-17 (Jan. 1961).

A survey is given of the theoretical approaches to the study of the low-density, high-temperature "classical" plasma and of the high-density, low-temperature "quantum" plasma. The random phase approximation (RPA), collective-variables method is shown to yield the same result as the collisionless Boltzmann equation combined with the self-consistent field method. Dynamic behavior is studied in the classical plasma, with particular attention to the relationship between individual particle and collective behavior. The frequency and wave number dependent longitudinal dielectric constant of the plasma is used to establish the many similarities in behavior of quantum and classical plasmas in the RPA; the validity of the RPA is discussed. Applications of the theory are made to the ground state energy of the quantum plasma and to the explanation of the characteristic energy losses in solids. The generalizations

required to take into account the ionic motion are indicated and the results are described. (auth)

17658 THE TOMONAGA METHOD AND SOME OF ITS APPLICATIONS. D. ter Haar (Clarendon Lab., Oxford). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 25-6 (Jan. 1961).

An account is given of Tomonaga's method of introducing collective coordinates. This method is applied to a derivation of the dispersion relations for plasma oscillations. The result is different from the one obtained by Pines and Bohm and possible reasons for this difference are given. Jepsen's method for deriving the hydrodynamic equations of motion is examined. (auth)

17659 PHONONS AND PLASMONS. R. Brout (Cornell Univ., Ithaca, N. Y.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 46-50 (Jan. 1961).

The interaction of a heavy positive plasma (mass M) with a light negative plasma (mass m) is examined in the random phase approximation (RPA). The problem is solved in this RPA by a normal mode analysis, leading to a dispersion relation that is analyzed in detail. In the limit of low momentum transfer q, the results correspond to Coulomb interaction screened out with the Fermi-Thomas screening factor. Phonons arise with $c = \sqrt{m/3M}\, v_f$, and the plasma frequency is $\sqrt{(4\pi ne^2/\mu)}$ where μ is the effective mass; v_f = the Fermi velocity; n = the electron density; c = the sound velocity. The phonon decays into electron-hole pairs with a relaxation time given by conventional perturbation theory using a screened electron-ion interaction. The screening arises in terms of a renormalized coupling constant, using a conventional field theoretic analysis. At high-momentum transfer ($q > 2p_f$), the phonon is stable (i.e., the imaginary part of the dispersion relation as a function of complex variable vanishes) and the analytic character of the spectrum changes. This effect can lead to determination of the Fermi surface in metals. Its pertinence to the present theory is pointed out. (auth)

17660 COLLECTIVE OSCILLATIONS OF A SYSTEM OF INTERACTING FERMIONS. A. E. Glassgold (Univ. of California, Berkeley). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 51-6 (Jan. 1961). (UCRL-8889)

Collective oscillations for an infinite system of fermions are discussed for the general case where the force between two particles depends on the internal variables as well as on their relative separation and momentum. Two theories are reviewed; one is based on Sawada's treatment of the electron gas, and the other on a semiclassical treatment by Landau. (auth)

17661 THE ORIGIN OF THE CHARACTERISTIC ELECTRON ENERGY LOSSES IN ALUMINUM AND MAGNESIUM. C. J. Powell (Univ. of Western Australia, Nedlands). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 57-64 (Jan. 1961).

The characteristic electron energy loss spectra of aluminum and magnesium are measured by analyzing the energy distribution of 750, 1000, 1500 and 2020 ev electrons scattered by evaporated specimens through 90°. Measurements are also made of the loss spectra of aluminum-magnesium alloys of unknown composition using a primary electron energy of 1500 ev. The loss spectra of both elements are similar in that they are composed entirely of combinations of two elementary energy losses, 10.3 and 15.3 ev in aluminum and 7.1 and 10.6 ev in magnesium. The alloy spectra consist of combinations of a loss that varied between 10.6 and 15.3 ev in different specimens, and a low-lying loss that varied between 7.1 and 10.3 ev. From measurements of the relative positions and intensities of the two fundamental losses in each element, the observed changes in position and intensity of the low-lying loss in very thin films of aluminum and the changes in position of the two fundamental losses in the alloys, it is concluded that the larger fundamental loss in each specimen is due to plasma excitation and that the smaller loss is a lowered plasma loss. (auth)

17662 PLASMA STUDIES SURVEY OF EXPERIMENTS. I. MAINLY OPTICAL STUDIES. K. G. Emeleus (Queen's Univ., Belfast). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 65-8 (Jan. 1961).

The main topics dealt with are the significance of gas purity and the molecular gas problem; utilization of gross unresolved appearance of a plasma and the necessity for distinguishing between steady and oscillating plasmas, illustrated by reference to terminal conditions in moving striations; noise and turbulence; a possible quantal limitation imposed on time resolution by the Einstein coefficients for allowed and forbidden transitions; formulation of the excitation integral; and further examples of spectroscopic techniques, including use of interference filters, study of potential in sheaths, and a check on the voltage amplitude of so-called plasma electron oscillations. (auth)

17663 PLASMA STUDIES SURVEY OF EXPERIMENTS. II. MAINLY PROBE STUDIES. K. G. Emeleus (Queen's Univ., Belfast). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 69-72 (Jan. 1961).

A review is given of the classification of probes; general remarks on metal probes, and the construction of probes for volume exploration; the Langmuir-Druyvesteyn method for determining isotropic distributions, its theory, the problem of variable reflection coefficients, and Boyd's development of techniques; exploration of oscillating plasmas; and effects of negative ions on plasma fields and probe currents, and on the stability of discharges. (auth)

17664 CRITICAL POINTS IN THE THEORY OF ELECTRON BEAM DEVICES. J. R. Pierce (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 73-80 (Jan. 1961).

A number of pro. ems in the theory of electron beam devices such as traveling-wave tubes and klystrons are considered. Some of these problems, including multi-velocity flow, occur in mathematical formulation of other plasma problems. There are two approaches to the flow problem. In one, the electron flow is divided into streams according to the initial unperturbed velocities of the electrons; the variables are the densities and velocities in the various streams. In the other, velocity is regarded as a co-ordinate of phase space and the variable is the density in phase space. These approaches give different appreciations of the phenomena involved and lead to different mathematical difficulties, but are the same in content. Each demonstrates the non-existence of wave-type solutions in many infinite velocity distributions. Only a few specialized solutions of multi-velocity problems exist. Different spatial coordinates may be used. The Eulerian approach leads to no difficulties if boundary conditions are met at fluctuating boundaries. In the case of thin beams, it is sometimes useful to use displacements from the mean position of the particles as variables. In dealing with power flow in electron beams, either the actual physical system may be replaced with a linear system and an expression found for power in this

system, or the power flow in the true non-linear system may be dealt with. The former alternative is much simpler. Kinetic power, as well as electromagnetic power, is important in considering the orthogonality of wave-type components. In solving an actual physical problem, either various wave-type components may be assembled so as to satisfy the boundary conditions, or the problem may be solved by transform or perhaps by other means. Components of the solution must be regarded as merely a part of the solution of an actual problem, but they can sometimes be given a reasonable physical interpretation. Thus, waves with positive and negative powers are found. When two unattenuated waves having powers of the same sign are coupled together, beats are observed. When two unattenuated waves having powers of opposite signs are coupled together, growing and decaying waves are observed. Growing waves can also be produced when a moving discontinuity couples two unattenuated waves together. (auth)

17665 PLASMA DIFFUSION IN STELLERATORS. T. Coor (Princeton Univ., N. J.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 81-3(Jan. 1961).

During ohmic heating of plasma confined in a Stellarator it is observed that the plasma moves across the magnetic confining field at a much higher average velocity than is predicted by classical considerations. An attempt is made to compare the observed velocity with drifts calculated from the randomly varying electric fields and density gradients in the plasma. It is found that the random quantities, as measured by double probes, are of sufficient intensity to give order-of-magnitude agreement between observed and calculated velocities. An hypothesis is put forward to explain the origin of these high-amplitude fluctuations, an hypothesis that might be applicable to gas discharges generally. It is assumed that the non-Maxwellian electron distribution resulting from the applied electric field excites large amplitude, coherent plasma oscillations near the plasma frequency. These large amplitude oscillations act as the "pump" in a non-linear parametric amplification process. Thermal fluctuations, normally present with small amplitudes in quiescent plasmas, are amplified over a wide band of frequencies, both above and below the pump frequency, by the resulting parametric amplifier action of the plasma. This results in high-amplitude noise which might produce enhanced diffusion and rapid thermalization effects. (auth)

17666 ION CYCLOTRON HEATING OF A PLASMA. T. H. Stix (Princeton Univ., N. J.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 84-7(Jan. 1961).

Experiments with ion cyclotron heating of a deuterium plasma confined in the B-65 Stellarator are reported. Single-particle type behavior is evidenced by the production of neutrons, ascribed to deuterons accelerated in the low density region beneath the induction coil but at the outside of the plasma, at a value B_0 of confining magnetic field corresponding to single particle resonance. Ion cyclotron wave behavior is indicated by the emission of light from deuterium and from several times ionized impurity elements, the light intensity peaking at a value of the magnetic field about 10% larger than B_0. Maximum absorption of the ion cyclotron wave energy is calculated to occur in a cylindrical shell where the ion density is about 10^{13} cm^{-3}, and qualitative support is given experimentally by the emitted light profile. Complete ionization of the deuterium plasma may be obtained using r.f. induction heating alone, with the highest electron temperatures occurring for magnetic fields corresponding to ion cyclotron wave resonance. Operation of the B-65 machine as a magnetic mirror confinement device with ion cyclotron heating leads to neutron production, induction coil loading, emission of deuterium and impurity light similar to Stellarator operation. (auth)

17667 TRAVELLING WAVE INTERACTION IN PLASMAS. G. D. Boyd and R. W. Gould (California Inst. of Tech., Pasadena). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 88-9 (Jan. 1961).

Interaction between a slow space-charge wave which travels along a cylindrical plasma column and an electron beam which passes down the axis of the column is demonstrated experimentally. A spatially growing wave exists when the velocity of the beam is approximately equal to the velocity of the unperturbed wave. (auth)

17668 OPTICAL PROPERTIES AND EMISSION OF RELATIVISTIC PLASMAS AT CYCLOTRON RESONANCE. D. B. Beard (Univ. of California, Davis). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 94-7(Jan. 1961).

The cyclotron emission from a hot, completely ionized, magnetically-confined plasma is estimated by computing the absorption of an incident plane wave. The harmonics of the fundamental cyclotron frequency, which are emitted perpendicular to the magnetic field direction, are summed over and also treated individually. Because of the Doppler effect and the relativistic variation in mass the behavior of the electrons and the electromagnetic properties of the medium are functions of electron velocity. Assuming a Maxwell-Boltzmann distribution in electron velocity, the polarization of the plasma is computed by integrating over electron velocity. Solution of Maxwell's equations yield the optical constants of the plasma and thereby the absorption of an incident wave. By invoking Kirchhoff's relation, the emission of the plasma is then determined. (auth)

17669 THE CONCEPT OF CONDUCTIVITY. J. E. Drummond, R. A. Gerwin, and B. G. Springer (Boeing Scientific Research Labs., Seattle). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 98-108(Jan. 1961).

The concept of conductivity in a hot plasma is reviewed. It is shown that even for arbitrarily small field strengths, a proportionality constant (tensor) does not in general exist between a frequency component of the field strength and the corresponding component of current density. Rather, insisting upon such a proportionality for a homogeneous plasma, defines a complete set of spatial field configurations (eigenfunctions of the conductivity). Each of these eigenfunctions separately satisfies Maxwell's equations. However, for an inhomogeneous plasma, even this is not possible since the eigenfunctions of conductivity are not separately solutions of Maxwell's equations. It is possible, however, to define an intrinsic high-frequency property of an inhomogeneous plasma. This does not relate current density to field strength but, rather relates the field strength produced by the current density to the field strength causing the current density. Both Maxwell's equations and the particle dynamics are represented in this new property of the inhomogeneous plasma. Equating the produced and causing field strengths again defines eigenfunctions in terms of which the solution for arbitrary boundary conditions can be found. (auth)

17670 EXPERIMENTS ON INTERACTION OF PLASMAS AND MICROWAVES. J. G. Linhart (CERN, Geneva). J. Nu-

clear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 109-11(Jan. 1961).

A microwave cavity resonator that contains a cylindrical linear plasma is described. The resonant modes of the cavity and the axial electric field distributions at these modes are measured in the presence of the plasma. Preliminary results and interpretations are given. (T.F.H.)

17671 CONFINEMENT OF AN ELECTRON BEAM BY OSCILLATING ELECTROMAGNETIC FIELDS. E. S. Weibel and G. L. Clark (Space Tech. Labs., Inc., Los Angeles). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 112-16 (Jan. 1961).

A charged particle can theoretically be bound in stable orbits about the axis of a circular wave guide by the fields of the TE_{01} mode at cut-off. This result is verified experimentally. The apparatus consists of a 20 cm section of a circular wave guide—properly terminated—into which is fed r-f power from a magnetron at f = 9.29 kMc in 2 μsec pulses. A uniform TE_{01} field is excited over the entire length of the guide. An electron beam injected axially at one end of the cavity diverges strongly due to Coulomb repulsion if no r-f power is applied. During the r-f pulse, however, the beam is confined to the axis and 90% of the current is collected by an axial probe of 0.3 cm diameter which is located at the other end of the guide. Between pulses when no r-f is applied, no measurable current reaches the probe. In its trajectory from the gun to the probe each electron spends about 170 r-f periods in the focusing field. (auth)

17672 PLASMA OSCILLATIONS. K. G. Emeleus and D. W. Mahaffey (Queen's Univ., Belfast). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 117-18(Jan. 1961).

Some experiments on kMc oscillations are surveyed. These oscillations, which are believed to be mainly longitudinal, are generated when an electron beam traverses a plasma. The oscillations provide evidence for the mechanism of collapse of directed motion. The bearing of this evidence on astrophysical and heavy-current problems is shown. The probable importance of electron concentration gradients, as evidenced by experiments, is studied. (auth)

17673 MAINTENANCE OF EQUILIBRIUM BY INSTABILITIES. O. Buneman (Stanford Electronics Research Labs. and Peterhouse, Cambridge, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 119-34(Jan. 1961).

Collective interactions can provide a rapid mechanism for restoring grossly non-Maxwellian distributions to near-Maxwellian, in that electrodynamic instabilities will build up to high levels within a few plasma periods. Computation of the further development of the instabilities in the non-linear regime shows an approach to statistical randomness. (auth)

17674 INSTABILITIES AND GROWING WAVES IN ELECTRON BEAM DEVICES. J. R. Pierce (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 135-7(Jan. 1961).

Some forms of electron flow are unstable in the sense that perturbations grow with time. Such instabilities are not associated with wave components which grow with distance for real frequencies. There is a large class of amplifiers whose operation can be explained in terms of spatially growing waves. The physical mechanism can be variously described as instability in a moving coordinate system, as a result of a negative dielectric constant at the frequency of operation which causes electrons to attract rather than to repel one another, as a result of coupling between positive energy and negative energy waves, or in other terms. In the easitron, an inductive wall results in growing waves. In the resistive wall amplifier, the abstraction of power from negative energy waves results in growth. In the traveling-wave tube amplifier, a positive power circuit wave is coupled to a negative power space-charge wave. In the double stream amplifier, the negative power space-charge wave of the faster stream is coupled to the positive power space-charge wave of the slower stream. In velocity-jump and rippled stream amplifiers, periodic discontinuities couple the positive power and negative power waves of the same stream. In wave-type parametric amplifiers, moving periodic discontinuities couple 2 unattenuated waves. The explanations of these devices are convenient in connection with the particular device, rather than unique. (auth)

17675 PLASMA INSTABILITIES ASSOCIATED WITH ANISOTROPIC VELOCITY DISTRIBUTIONS. E. G. Harris (Oak Ridge National Lab., Tenn. and Univ. of Tennessee, Knoxville). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 138-45(Jan. 1961).

The general dispersion relation is derived for small amplitude waves in a fully-ionized plasma in an external magnetic field. This derivation is based on the Vlasov equations (Boltzmann equations without collision terms for the electrons and ions, plus Maxwell's equations). The dispersion relation involves integrals over the zeroth order velocity distributions. It is found that for sufficiently anisotropic velocity distributions waves exist which have exponentially growing amplitudes. Special cases are discussed. It is shown that streams of charged particles passing through a plasma may excite either longitudinal or transverse waves. Other instabilities exist when the distributions are such that the velocities of the particles are perpendicular to the magnetic field. (auth)

17676 A QUASI-LINEAR MODEL OF PLASMA SHOCK STRUCTURE IN A LONGITUDINAL MAGNETIC FIELD. E. N. Parker (Univ. of Chicago). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 146-53(Jan. 1961).

Interpenetration of 2 plasma streams along a uniform magnetic field is prevented by the hose instability. Thus the shock thickness resulting from supersonic streaming of a tenuous plasma along a uniform magnetic field may be very much less than the collision length. It is suggested that an actual stationary shock front under these conditions is formed by the hose interaction between the incoming supersonic stream and a precursor, consisting of ions evaporating forward from the non-linear disordering that results when the hose instability reaches large amplitude. Treating the growth of the hose instability with an approximation to the linearized equations, it is shown that the scale of the shock front is characterized by the ion and electron Larmor radii, and that the density in the precursor relaxes to a small but non-vanishing value, proportional to one over the square of the Mach number, infinitely far ahead of the shock. (auth)

17677 ON THE RADIATION FROM CO-OPERATIVE PHENOMENA IN PLASMAS. C. Oberman (Princeton Univ., N. J.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 154-7(Jan. 1961).

The knowledge of the interaction of a bounded plasma with external magnetic fields is important. The general properties of the radiation due to plasma oscillations of bounded

plasmas of single geometries situated in a strong magnetic field are investigated. The special problems of transmission, reflection and scattering due to plasma slabs and columns are also discussed, as well as the problems of the response of the plasma to fields in the vicinity of its surface. The effects of thermal spread in the particle velocity distribution are included. (auth)

17678 NON-LINEAR EFFECTS IN ELECTRON PLASMAS. P. A. Sturrock (Stanford Univ., Calif.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 158-63(Jan. 1961).

The effect of non-linear terms in the dynamical equations governing wave propagation in plasmas may be analyzed by a perturbation procedure that is acceptable for amplitudes that are not too large. The Hamiltonian describing the complete system is separated into 2 parts: the quadratic part that yields the linearized equations, and the non-linear part. The quadratic part may be eliminated by a normal-mode analysis, the "normal modes" comprising traveling waves. The non-linear part then results in interaction between these waves. Two theorems concerning wave interaction are proved. The first relates energy-transfer between a group of interacting waves to the frequency of these waves. This "action-transfer relations" lead to relations for steady-state or quasi-steady-state configurations. The second theorem relates the frequency-displacements of a group of interacting waves to the energies of these waves. The properties of electron plasmas undergoing longitudinal oscillations are examined in the light of the preceding theorems. Interaction terms may be classed as "coherent" and "incoherent": the former do not result in energy transfer but only frequency displacement which may be characterized by a dispersion relation. The second group leads to transfer of energy between waves and hence to spectral decay. The interaction between longitudinal (electrostatic) and transverse (electromagnetic) waves in plasmas is considered and it is shown that in a uniform plasma in the absence of magnetic fields, the dominant interaction couples 2 longitudinal waves with 1 transverse wave. The dominant non-linear mechanism for radiation from excited plasmas should lead to emission at twice the plasma frequency. (auth)

17679 EXPERIMENTAL STUDY OF A PLASMA COLUMN IN A MICROWAVE CAVITY. S. J. Buchsbaum (Bell Telephone Labs., Inc., Murray Hill, N. J.), E. I. Gordon, and S. C. Brown. J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 164-8(Jan. 1961).

Experiments designed to study the production of a steady-state plasma column by microwave cavity means are described. At low plasma densities electrons are heated by cyclotron resonance in crossed microwave electric and static magnetic fields. Phenomena associated with large energies which the electrons possess near cyclotron resonance are discussed. Large plasma densities are achieved by resonating the plasma column by suitably varying the static magnetic field, the microwave frequency and the input power. In this manner, densities of the order of 10^{12} cm^{-3} are obtained at a neutral gas pressure in the micron range. (auth)

17680 DYNAMICS OF CLASSICAL MANY-BODY SYSTEMS. E. P. Gross (Brandeis Univ., Waltham, Mass.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 173-83(Jan. 1961).

The theory of small-amplitude disturbance propagation in monatomic gases and plasmas is examined. The problem is analyzed in terms of kinetic equations for 1-particle velocity distributions involving self-consistent field forces and Boltzmann-like collision terms. The problem is treated in a more fundamental way by means of a microscopic development, utilizing a microscopic form of the classical n-body problem. Other results of this microscopic formulation are examined. (T.F.H.)

17681 ON THE MOTION OF A CHARGED PARTICLE. I. Prigogine (Université Libre, Brussels). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 184-7(Jan. 1961).

The motion of a charged particle, including the effect of its self field, is treated in the frame of classical mechanics by the Liouville statistical mechanical method. The results are summarized for a free particle in vacuum, a free particle in a black body, and a harmonic oscillator. In every case the partial differential equation giving the evolution of the particle phase distribution function is established. (auth)

17682 NON-EQUILIBRIUM THERMODYNAMICS OF SYSTEMS IN AN ELECTROMAGNETIC FIELD. S. R. de Groot (Univ. of Leiden). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 188-94(Jan. 1961).

A review is given of applications of thermodynamics of irreversible processes to systems in the presence of an electromagnetic field. The mass, momentum and energy conservation laws and the entropy balance equation are developed for mixtures without and with electric and magnetic polarization, and also for systems in which the momentum transfer between some of their components is inhibited. (auth)

17683 FOKKER-PLANCK EQUATION FOR A PLASMA WITH A CONSTANT MAGNETIC FIELD. N. Rostoker and M. N. Rosenbluth (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 195-205(Jan. 1961).

Starting from the Liouville equation, a chain of equations is obtained by integrating out the coordinates of all but 1, 2,-etc. particles. One particle is singled out; all other particles are considered to be initially in thermal equilibrium. For the time evolution of the distribution function of the "singled out" particle an equation is obtained whose asymptotic form is of the usual Fokker-Planck type. It is characterized by a frictional drag force that slows the particle down and a fluctuation tensor that speeds it up and produces diffusion in velocity space. These quantities are determined for a plasma consisting of electrons and protons in a constant external magnetic field. The chain of equations contains 2 dimensionless parameters λ and g. A solution for the s-body correlation function is obtained in the form $f_s = f_s^{(0)}(\lambda) + g f_s^{(1)}(\lambda) +$ etc. $f_s^{(0)}$ and $f_s^{(1)}$ are determined to all orders of λ. The frictional drag consists of a part due to collisions and a part due to plasma wave emission. When $\lambda \ll 1$ the modification of the collisional part due to the magnetic field is negligible. There is a significant change in the properties of plasma waves of wavelength greater than the Larmor radius; this wavelength effect modifies the force due to plasma wave emission. When $\lambda \gg 1$ the force due to plasma wave emission disappears. The collisional force is altered to the extent that the maximum impact parameter lies between the Larmor radius and the Debye length. A modification is obtained for the case of a slow ion moving perpendicular to the field, because of repeated collisions with fast electrons. In addition to the drag force anti-parallel to the velocity of the particle, there is a collisional force anti-parallel

to the Lorentz force. This force arises because the particle and its "shield cloud" are spiraling about field lines. The force on the particle is equal and opposite to the centripetal force acting on the "shield cloud." It is much smaller than the Lorentz force. To the lowest order in g, the frictional drag and fluctuation tensor are slowly varying functions of λ. (auth)

17684 CLASSIFICATION OF DIAGRAMS FOR A PLASMA EQUATION-OF-STATE. H. B. Levine (Univ. of California, Livermore). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 2: 206-17(Jan. 1961). (UCRL-5618)

Utilizing the Montroll-Ward approach to quantum statistics, generalized to many components, an equation of state is obtained for a high-temperature low-density plasma. A classification of diagrams is proposed analogous to that used in classical statistical mechanics. In the resulting expansion, the leading term is the ideal gas contribution plus the lowest-order exchange contribution plus the ring contribution, the latter representing the pressure effect of collective motions of a completely ionized plasma. Higher terms represent, successively, contributions of 2-, 3-, 4-, etc., particle states, including modifications of the single-particle motions. The classification eliminated the ultraviolet catastrophe which ordinarily arises in the treatment of Coulomb force bound states in statistical mechanics, since, in effect, it uses a screened Coulomb potential instead of the ordinary potential. In addition, the short range divergence, which occurs in classical theory because of the "fall" of the electron to the nucleus, does not arise, being prevented by the uncertainty principle. (auth)

17685 EXCITATION OF STATIONARY WAVES IN PLASMA. R. Leven. Vestnik Moskov. Univ., Ser. III, Fiz. Astron., 15: No. 4, 32-7(June-Aug. 1960). (In Russian)

A dispersion equation, derived for electron beam excitation of standing wave in confined plasma, enables a determination of the frequencies and increment values at any arbitrary ratio of beam and plasma densities without using computers. The results are analyzed and correlated with published data. (R.V.J.)

17686 THE NON-STATIONARY ROTATING OF PLASMA IN MAGNETIC FIELD. G. V. Gordeev (Ioffe Leningrad Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Tekh. Fiz., 31: 271-82(Mar. 1961). (In Russian)

A solution is developed for the problems of plasma rotation in a constant magnetic field, considering the effects of cylindrical coaxial electrodes and plasma boundaries. (tr-auth)

17687 PRESSURE OF NON-HOMOGENEOUS HIGH-FREQUENCY MAGNETIC FIELD ON PLASMA OF GASEOUS POSITIVE DISCHARGE. K. S. Golovanevskii and A. A. Kusovnikov (Moscow [State] Univ.). Zhur. Tekh. Fiz., 31: 343-7(Mar. 1961). (In Russian)

The influence of a nonuniform alternating field on low-pressure discharge in a positive plasma column was studied. It was found that a high-frequency heterogeneous electric field exerts a pressure on the plasma toward the discharge axis. Experiments were made to determine the qualitative characteristics of the effect. The probe characteristics and the magnitude of compression as functions of ring potential and frequency are plotted for discharges in argon. (R.V.J.)

17688 THE CHALLENGE OF FUSION. Duncan Curry, III and Bertram R. Newman. Princeton, N. J., D. Van Nostrand Company, Inc., 1960. 200p.

A general outline of controlled thermonuclear (CTN) research is given, including stellarators, magnetic mirrors, the pinch effect, and Sherwood Project. A speculative outline of possible and probable uses of CTN power for industry and global progress is presented. (T.F.H.)

Shielding

17689 (AEET/HP/TH/5) GAMMA DOSE ATTENUATION CALCULATOR (Slide Rule). C. M. Sunta (India. Atomic Energy Establishment, Trombay). July 1, 1960. 40p.

The physical principles underlying the design, construction, and use of a gamma dose attenuation slide rule are described. The slide rule can be used for shielding calculations for point sources of gamma rays of any energy between 0.3 and 3 Mev and for lead, iron, concrete, and water as shielding material. Graphs and tables of K factors, tenth value layers, and transmission factors with various thicknesses of the shielding materials are included for monoenergetic gamma rays of 0.5 to 3 Mev energy and for a number of complex gamma emitters. (D.L.C.)

17690 (NP-10038) NRDL–OCDM SHIELDING SYMPOSIUM PROCEEDINGS, OCTOBER 31–NOVEMBER 1, 1960. Reviews and Lectures No. 110. (Office of Civil and Defense Mobilization, Battle Creek, Mich. and Naval Radiological Defense Lab., San Francisco). 501p.

Presented are the proceedings of the NRDL–OCDM Shielding Symposium, which was organized to provide a review of work going on, the state of the shielding art, and future needs toward development of a broadly applicable shielding technology. Separate abstracts were prepared for 29 papers. (B.O.G.)

17691 (NP-10038(p.9-13)) ARMY RADIOLOGICAL SHIELDING REQUIREMENTS. Robert M. Montague, Jr. (Army, Washington, D. C.).

A discussion is given of what the Army will look like in 1965 to 1970; the doctrine, equipment, and tactics. Onto this framework estimates are given of the general shielding requirements. (B.O.G.)

17692 (NP-10038(p.14-24)) IS FURTHER RESEARCH ON WEAPON AND FALLOUT SHIELDINGS NECESSARY? Gordon K. Dicker (Air Force, Washington, D. C.).

17693 (NP-10038(p.25-37)) U. S. NAVY REQUIREMENTS FOR SHIELDING INFORMATION. R. W. King (Naval Radiological Defense Lab., San Francisco).

Shielding is a central countermeasure against radiation whether from controlled nuclear processes or phenomena resulting from nuclear weapons detonations. This fact dictates a militiary interest in knowledge of shielding capability and analytical techniques for its determination. The Navy has, therefore, supported shielding research in both its fundamental and applied aspects. The Navy's interest in engineering applications is summarized. Although Navy interest extends to sea, air, space, and land environments, application of shielding information in ships is emphasized. (auth)

17694 (NP-10038(p.38-67)) SHIELDING RESULTS FROM WEAPONS EFFECTS TESTING. William D. Sheehan (Defense Atomic Support Agency, Washington, D. C.).

A discussion is given of measurements for gamma radiation, neutron flux, and shielding experiments during Operations Hardtack and Plumbbob. Graphical and tabulated results are included. (B.O.G.)

17695 (NP-10038(p.68-99)) PROGRESS IN RADIATION SHIELDING RESEARCH. Arthur B. Chilton (Naval Civil Engineering Lab., Port Hueneme, Calif.).

A summary is presented of progress attained in research on radiation shielding during the 1950's. In addition to theoretical achievements, experimental achievements are discussed for basic shielding problems, simplified structures, actual structures, and specialized problems, such as ship structures. (B.O.G.)

17696 (NP-10038(p.100-26)) OCDM INTEREST IN NUCLEAR RADIATION SHIELDING. Jack C. Greene (Office of Civil and Defense Mobilization, Battle Creek, Mich.).

A discussion is given of the applications of shielding information in OCDM programs which include, inventorying existing fallout protection, designing protective shelters, and war gaming. An analytical summary is given of structures and shelter spaces determined in a fall-out shelter survey for the Tulsa (Oklahoma) central business district. Designs of several protective shelters are illustrated for family and schools. The applications to war gaming are discussed according to damage assessments and risk computations. (B.O.G.)

17697 (NP-10038(p.127-37)) THE EFFECT OF SHELTERING ON FALLOUT FATALITIES. Arthur A. Broyles (Florida. Univ., Gainesville).

The discussion includes: the determination of the infinite plane radiation dose probability; the biological response functions for surface fall-out gamma irradiation, and Sr^{90}; and the expected fraction of the population killed by a bomb. An estimate of the effects of world-wide fall-out indicates that something like 250,000 megatons would have to be exploded before 1% of the world's children are likely to die eventually from the effects of Sr^{90}. (B.O.G.)

17698 (NP-100038(p.138-52)) METHOD FOR EVALUATING PROTECTION AFFORDED BY STRUCTURES AGAINST FALLOUT RADIATION. Charles Eisenhauer (National Bureau of Standards, Washington, D. C.).

Considerations are given for the dose rate three feet above an infinite smooth plane contaminated with radioactive fall-out, and the corresponding angular distribution inside a structure which has heavy walls and contains some windows. Diagrams are included for angular distributions in open fields, in structures with windows, for thin and thick walls, and for a detector at window-sill level. Reduction factors for radiation from ground sources around, and roof sources on the blockhouse. (B.O.G.)

17699 (NP-10038(p.153-72)) ENGINEERING APPLICATIONS OF FALLOUT GAMMA RADIATION SHIELDING RESEARCH. Neal FitzSimons (Office of Civil and Defense Mobilization, Battle Creek, Mich.).

Functional equations with related graphs were developed for solving common shelter shielding problems. Examples were worked out to illustrate procedures for analyses involving both above- and below-ground shelters, as well as aperture problems. (auth)

17700 (NP-10038(p.173-8)) PROBLEMS ENCOUNTERED IN THE TEACHING OF SHIELDING ANAYLSIS AND DESIGN TECHNIQUES. James E. Roembke (Office of Civil and Defense Mobilization, Battle Creek, Mich.).

17701 (NP-10038(p.179-93)) PRELIMINARY MEASUREMENTS OF SHIELDING EFFECTIVENESS OF AN UNDERGROUND FALLOUT SHELTER. B. W. Shumway W. G. Miller, and G. E. Plummer (Naval Radiological Defense Lab., San Francisco).

A study was made of the protection offered by the NRDL–OCDM shelter to give indices of protection attributed to skyshine, lip penetration, and penetration through the roof. A description is given of the shelter which is placed underground and has an L-shaped entrance to have no line-of-sight leakage path for radiation. The protection factors are given according to the location in the shelter. (B.O.G.)

17702 (NP-10038(p.194-210)) MODELING AS A TECHNIQUE FOR DETERMINING RADIATION SHIELDING. John F. Batter, Jr. and Eric T. Clarke (Technical Operations, Inc., [Burlington, Mass.])

The application of the laws of scaling to shielding experimentation provides an attractive, economical alternative to the testing of large structures, and permits the evaluation of shielding effectiveness of new structures while they are still in the blueprint stage. In theory, perfect scaling can be achieved if all dimensions are reduced and all densities of materials (including the atmosphere and the ground) are increased by the same scaling factor. In practice, an achievement of a scaling factor of 1:12, large enough to be useful, requires compromises. Air and ground must, in general, be left unchanged and building walls constructed of a substitute material of higher density with approximately the same attenuation cross sections, to prevent them from becoming unduly thick. The resultant model will then approximate the interaction of radiation with the structure but will ignore the effects of ground and air scatter. Equipment used in the preliminary experiments to test the utility of this concept and comparison of the results of the experiments with full-scale tests are described. (auth)

17703 (NP-10038(p.211-22)) DOSE ATTENUATION FACTORS FOR CONCRETE SLAB SHIELDS COVERED WITH FALLOUT AS A FUNCTION OF TIME AFTER FISSION. L. K. Donovan (Naval Civil Engineering Lab., Port Hueneme, Calif.).

The study was made using the OCDM criterion of a two-week stay time in fall-out shelters. A factor was calculated for determining the dose received during that stay time as a function of the (H + 1)-hour dose rate, the time of arrival of fall-out after detonation or shelter entry time, and the slab thickness of the shelter roof. It is concluded that at no time after 1.12 hr will a person in a shelter for 14 days receive a greater dose than if fall-out arrives at 1.12 hr after fission. This is proven in that there are no maxima greater than at 1.12 hr for concrete thicknesses to 3 ft. (B.O.G.)

17704 (NP-10038(p.223-30)) SOURCE GEOMETRY EFFECTS ON GAMMA-RAY PENETRATION INTO A COMPARTMENTED STRUCTURE. S. Tomoeda, M. B. Hastings, and B. W. Shumway (Naval Radiological Defense Lab., San Francisco).

Dose rates were measured in the various compartments using air-wall equivalent dosimeters with the source at various distances from the box. The results are presented as geometry factors as a function of source-to-detector distance. The geometry factor is defined here as the ratio of the measured dose rate to the unattenuated primary dose rate calculated for a given point. The need for this type of information arises in working out prediction methods for dose rates inside complex structures, such as ships and buildings caused by volume distributed contaminations. (B.O.G.)

17705 (NP-10038(p.238-50)) RESULTS OF EXPERIMENTAL INVESTIGATION ON GAMMA TRANSPORT AND SHIELDING PROBLEMS. Hans J. Tiller, R. Rexroad, M. Schumchyk, and M. Schmoke (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.).

The work presented is part of a shielding program to study the protection by structures and fortifications against residual radiation from Co^{60} and Cs^{137}. Results are dis-

cussed for investigations of open field build-up and dose rates above a contaminated plane, ground penetrating radiation in a cylindrical foxhole, and dose rates in a blockhouse from roof contamination. (B.O.G.)

17706 (NP-10038(p.253-65)) NUCLEAR WEAPONS RADIATION DOSES IN ARMORED VEHICLES. C. W. Hill and W. B. Ritchie (Lockheed Nuclear Products, Marietta, Ga.).

A review is given of the methods used in analytic study for predicting the dose to crew members of an M-48 tank exposed to a nuclear weapons burst. The variation of armor thickness, 1 to 7 in., combined with the anisotropy of the radiation field, indicates that the dose is quite sensitive to burst orientation and detector position. The comprehensive calculations are made by mapping the vehicle surface with a complex polyhedron. Vehicle geometry parameters and dose transmission for the vehicle geometry are calculated once for each vehicle, while crew dose calculations are made for each source orientation and range. (B.O.G.)

17707 (NP-10038(p.266-92)) RADIATION STREAMING IN SHELTER ENTRANCEWAYS. Charles W. Terrell (Illinois Inst. of Tech., Chicago. Armour Research Foundation).

A description is given of a series of analytical and experimental efforts directed toward the determination of gamma ray and neutron distributions in ducts and entranceways. The albedo recipe is applied but with considerable modification and rigor. The agreement of the albedo model and experiment is rather good for gamma rays and poor for neutrons. (B.O.G.)

17708 (NP-10038(p.293-300)) PROGRESS ON RADIATION SHIELDING RESEARCH TANKS. William D. Sheehan (Defense Atomic Support Agency, Washington, D. C.) and Frank Allen (Ballistic Research Labs., Aberdeen Proving Ground, Md.).

A description is given of studies made on the transmission of radiation through present combat tanks, and radiation transport characteristics of materials and geometries which are directly involved with the development of a radiological combat vehicle. (B.O.G.)

17709 (NP-10038(p.301-7)) THE EFFECT OF AN AIR-SAND INTERFACE ON GAMMA-RAY TRANSPORT. D. C. Kleinecke (California. Univ., Berkeley).

A description is given of Monte Carlo calculations for gamma flux from an isotropic, monoenergetic point source lying on an interface between air and sand. The results include the sample means and standard errors tabulated separately for each order of scattering for the energies considered: 0.097, 0.280, 0.662, and 1.700 Mev. (B.O.G.)

17710 (NP-10038(p.308-95)) A MONTE CARLO CALCULATION OF GAMMA-RAY AND FAST-NEUTRON SCATTERING IN AIR. M. B. Wells (Convair, Fort Worth, Tex.).

The calculations were made for source-detector separation distances up to 1500 yards to provide information on the radiation field resulting from a nuclear weapon burst. The calculated fluxes and dose rates were multiplied by $4\pi R^2$, where R is the source-detector separation distance, and the results normalized to a point isotropic source emitting one particle per second. The energy and angular distributions are tabulated for dose rates for gamma source energies of 0.5 to 6 Mev, and for fast neutron source energies of 0.75 Mev through fission. The average standard deviation for all problems was 18% of the calculated scattered flux. The standard deviation exceeds 20% in only 20% of the problems. The accuracy of the energy spectra and angular distributions should be within ± 30%. (B.O.G.)

17711 (NP-10038(p.396-415)) CALCULATIONS OF THE SPATIAL, ENERGY AND ANGULAR DISTRIBUTIONS OF WEAPONS RADIATION. R. L. French and M. B. Wells (Convair, Fort Worth, Tex.).

A description is given of the calculations of the distributions of initial gamma rays and neutrons from nuclear weapon explosions. The calculations are based on Monte Carlo results for air scattering of gamma rays and neutrons. The results were evaluated by comparison with the measured data for nominal bombs of 10 to 20 kilotons. The calculated spatial distribution of the gamma and neutron doses, and neutron fluxes is generally within 70% of the corresponding measured data. Similar agreement was obtained for the neutron energy distribution. (B.O.G.)

17712 (NP-10038(p.416-23)) NEUTRON FLUXES FROM A POINT FISSION SOURCE IN AIR: MOMENTS METHOD CALCULATION. David Spielberg (Nuclear Development Corp. of America, White Plains, N. Y.).

The calculations were made using RENUPAK, a neutron moments-method program for the IBM 704. The calculations were based on the point values of the neutron cross sections and angular distributions for nitrogen and oxygen at 215 energies, from 0.009 ev to 18 Mev. The results indicate that the neutron spectra does not vary strongly with distance from the source. This is further illustrated by graphs of the neutron spectra for penetrations of 30, 90, 210, and 400 g/cm^2. A comparison is given between the spectrum at 30 g/cm^2 and the source fission spectra. Neutron doses are shown as a function of distance, computed for a fission source of 1 kiloton (TNT) energy yield. (B.O.G.)

17713 (NP-10038(p.424-31)) THE BOEING SHIELDING RESEARCH PROGRAM. Brian W. Mar (Boeing Airplane Co., Seattle).

A description is given of the program which is designed to encourage fundamental research to supplement applied radiation shielding work in nuclear weapons, reactors, and outer space. (B.O.G.)

17714 (NP-10038(p.432-46)) EXPERIMENTAL REACTOR SHIELDING RESEARCH AT ORNL. Everitt P. Blizard (Oak Ridge National Lab., Tenn.).

The central shielding problem at ORNL is that of shielding a crew on a nuclear powered airplane. In addition to shielding experiments which are directly useable in shield design, research is directed to certain aspects of the basic shielding problem. A discussion is given of measurements of low energy distributions of neutrons in angle and energy. A lithium-iodide scintillation spectrometer developed for use in shielding measurements is described. Discussions are given of applications of the Lid Tank Shielding Facility and Tower Shielding Facility in shielding research. (B.O.G.)

17715 (NP-10038(p.447-52)) NEUTRON TRANSPORT STUDIES. Hermann J. Donnert (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.).

An outline is given of neutron transport studies conducted toward the solution of the source data problem for radiation environments caused by nuclear weapon detonations in air and at high altitudes. (B.O.G.)

17716 (NP-10038(p.453-67)) MONTE CARLO INVESTIGATION OF NEUTRON CAPTURES IN BORATED IRON SLABS. J. C. Whiton and M. O. Burrell (Lockheed Nuclear Products, Marietta, Ga.).

The program treats an incident beam of monoenergetic neutrons from either an isotropic or a monodirectional source and computes boron and iron capture distribution, and albedo and transmission characteristics. The investi-

gation was carried out to determine the secondary gamma dose in one- and three-inch iron slabs with a boron content of zero to seven per cent by weight, at incident energies of from 0.1 to 3500 ev. (B.O.G.)

17717 (NP-10038(p.468-73)) NEUTRON ATTENUATION IN LAYERED IRON–WATER SYSTEMS. Glenn Murphy (Iowa. State Univ., Iowa City).

Discussions are given of the applications of Monte Carlo techniques to the determination of neutron distributions in a series of alternating semi-infinite slabs of iron and water, and experimental work in the study of neutrons in iron-water systems. (B.O.G.)

17718 (NP-10038(p.474-91)) FUTURE NEEDS IN SHIELDING RESEARCH AND THEORY. L. V. Spencer (National Bureau of Standards, Washington, D. C.)

17719 (NP-10038(p.492-4)) STATUS OF SHIELDING RESEARCH IN RELATION TO APPLICATIONS AS REVEALED BY THIS SYMPOSIUM. Eugene P. Cooper (Naval Radiological Defense Lab., San Francisco).

17720 (RM-1624(RAND)) WEIGHT-FEASIBILITY CALCULATION FOR SHIELDING OF TRUCK PASSENGERS. T. E. Harris (RAND Corp., Santa Monica, Calif.). Feb. 3, 1956. 24p.

A shielded structure suitable for carrying passengers on a truck is proposed. The weight of shielding material required for a given degree of shielding is calculated on the basis of a roughly optimum distribution of the material. The results of the calculations are shown graphically. It is suggested that the results be used in accordance with the included modifications. (auth)

17721 SHIELDING MATERIALS FOR NUCLEAR REACTORS. A. N. Komarovskii. Translated from the Russian by V. M Newton. H. W. Curtis, translation ed. International Series of Monographs on Nuclear Energy. Division VII. Reactor Engineering. Volume 1. New York, Pergamon Press, 1961. 151p. $9.50.

Concretes used in reactors and accelerators are examined; shielding, technological, and engineering properties of these concretes are studied. Particular attention is given to special heavy and hydraulic concretes. Radiation hazards, construction methods, and economic considerations are summarized for the concretes studied. (T.F.H.)

17722 PROTECTION SCREEN AGAINST THERMAL NEUTRONS AND ITS MANUFACTURING PROCESS. A. Paganelli. Belgium Patent 580,330. Aug. 4, 1959. (In French)

Instead of manufacturing expensive BC plates, granules of B or BC are incorporated in a suitable metallic or non-metallic binding material, heated, and sprayed onto the surface to be shielded from either γ rays or neutrons. (EURATOM)

17723 IMPROVEMENTS IN OR RELATING TO SCREENS ADAPTED TO GIVE PROTECTION AGAINST NEUTRONS. Edgar Wilhelm Reissner (to Factories Direction, Ltd.). British Patent 865,435. Apr. 19, 1961.

Screens which give protection against thermal and fast neutrons may be made comprising layers of hydrogen carrier interleaved with boron-containing layers. In one preferred embodiment of the fabrication procedure, the hydrogen carrier is a paper film impregnated with synthetic phenol-formaldehyde resin, and the boron-containing layers are layers of boric oxide bound in thin resin layers. Details of the fabrication processes are given. (D.L.C.)

17724 AN IMPROVED SHIELDING MATERIAL FOR USE AGAINST INJURIOUS RADIATION. (to Associated Lead Manufacturers Ltd.). British Patent 868,524. May 17, 1961.

A description is given of a slab or other thick shaped piece of rigid material for use in the construction of an enclosure affording protection against radiation. The slab consists of unplasticized polyethylene or polypropylene with uniformly dispersed powdered lead or tungsten. The metal to plastic ratio is within the range 1:1 to 30:1. Boron is also added uniformly in an amount of 1% of the total weight. The slab is fabricated in a mold which allows air to escape but does not allow a substantial amount of the plastic material to escape. The mold has an unheated base plate and heated top ram and side walls. Space is left between the side walls and base plate to allow air to escape. (N.W.R.)

Theoretical Physics

17725 (CERN-61-8) GROUP THEORY AND SPECTROSCOPY. Giulio Racah (Hebrew Univ., Jerusalem). Spring, 1951. 58p.

Reprint of Lectures delivered at the Institute for Advanced Study, Princeton, 1951. Reissued by: European Organization for Nuclear Research, Geneva, Mar. 6, 1961.

Applications of group theory to problems of spectroscopy and nuclear structure are discussed. Topics covered include continuous groups, classification of semi-simple groups, representations of semi-simple groups, eigenfunctions of nuclear shells, and calculation of energy matrix. (M.C.G.)

17726 MODEL OF A COULOMB CHARGE IN NONLINEAR FIELD THEORY. Karl Beckert and Jochen Lindner (Universität, Mainz). Ann. Physik (7), 6: 361-9(1960). (In German)

The nonlinear field theory developed by K. Bechert has solutions which correspond to a charged particle whose charge is represented by a charge density which is zero in the particle center, increases to a maximum against the particle edges, and then again decreases. The linear expansion of the particles was measured by the characteristic length L, which accurately represents the classical particle radius; for an electron L is equal to the classical electron radius. The physical magnitudes integrated over a random spatial area are all infinite. In the theory a dimensionless number of the order-of-magnitude of 10^{42} occurs. The particle was held together by gravitational forces which counteract the electrical repulsion. With the solution given, the objection that a gravitation theory can yield no theory of elementary particles since the characteristic length of the particle must be the Einstein gravitation radius is refuted. The Einstein gravitation theory does not occur in the present work. (tr-auth)

17727 HEISENBERG REPRESENTATION IN CLASSICAL GENERAL RELATIVITY. R. Arnowitt, S. Deser, and C. W. Misner (Syracuse Univ., N. Y. and Brandeis Univ., Waltham, Mass.). Nuovo cimento (10), 19: 668-81(Feb. 16, 1961). (In English)

A classical Heisenberg representation which excludes Hamilton-Jacobi-like canonical transformations is defined. The freedom of co-ordinate transformations in general relativity allows many extra canonical transformations not found in conventional Lorentz covariant theory. This wider class of canonical formalisms possess all the properties usually associated with the Heisenberg picture in that in each formalism the measurable quantities, $g_{\mu\nu}(t)$, are obtained from knowledge of the canonical variables at the same time without any explicit co-ordinate dependence.

Further, the Hamiltonian is a constant of motion. Only in Heisenberg frames is the Hamiltonian to be associated with the energy of the system. In spite of the additional freedom of canonical transformations, it is shown that the Hamiltonian is numerically the same for a fixed state of the gravitational field in any Heisenberg representation. The energy is then a uniquely definable quantity in the theory. In the process, it is established that two Heisenberg frames can differ by co-ordinate transformations that depend only on the canonical variables and not explicitly on the co-ordinates. These transformations must also preserve the property that at spatial infinity the metric become Lorentz so that the physical boundary conditions be unaltered. (auth)

17728 UNITARITY OF THE S-MATRIX AND ANALYTICITY. [PART] I. R. Ascoli (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin), A. Bottino, and A. Molinari. Nuovo cimento (10), 19: 687-95(Feb. 16, 1961). (In English)

The problem of finding which analyticity properties of the production amplitudes are required to deduce, by means of the S-matrix unitarity relations, analyticity properties of scattering amplitudes as functions of the momentum transfer is solved. The fundamental feature of the results is that analyticity properties of the production amplitudes are required as functions of two and only two dynamical variables, whichever be the number of produced particles. The general method given does not require the actual calculation of any integral. In particular, for the production amplitudes a condition is given sufficient for the analyticity within an ellipse of the imaginary part of the scattering amplitude as function of the momentum transfer. (auth)

17729 FLOW PROPERTIES OF SUPERFLUID SYSTEMS OF FERMIONS. A. E. Glassgold (Univ. of California, Berkeley) and A. M. Sessler. Nuovo cimento (10), 19: 723-37(Feb. 16, 1961). (In English) (UCRL-9223)

The nonspherically symmetric solutions to the Bardeen-Cooper-Schrieffer theory are given a physical interpretation in terms of an anisotropic fluid model. An investigation of the flow properties of such systems is made that involves the calculation of the effective mass for flow in a straight channel and the moment of inertia of a cylindrical container of the liquid. The angular dependent energy gap characteristic of this type of theory leads to an effective mass for flow that depends on the angle between the axis of symmetry of the fluid and the direction of flow. The effective mass for flow vanishes as the absolute temperature tends to zero, although not as rapidly as for a spherically symmetric gap. The moment of inertia, when the symmetry direction for the fluid and the rotation axis are the same, is simply related to the mass for flow. (auth)

17730 ON THE COMPLETE LORENTZ INVARIANT FIELD IN A TIMELIKE TUBE. H. J. Borchers (Universität, Hamburg). Nuovo cimento (10), 19: 787-93(Feb. 16, 1961). (In German)

That a complete field is already complete in a timelike tube is shown. This is a consequence of invariance and spectrum condition alone. (auth)

17731 RESONANCE EFFECTS IN INTERMEDIATE BOSON THEORY. P. T. Matthews and A. Salam (Imperial Coll., London). Nuovo cimento (10), 19: 837-9(Feb. 16, 1961). (In English)

If the intermediate boson follows the renormalizable pattern proposed by Tanikawa and Watanabe, there will be a resonance in the scattering $\nu + n \rightarrow p + e^-$ or $\nu + p \rightarrow n + e^+$ at quite low energies ($E_{lab} \simeq 300$ Mev), readily accessible to medium energy proton accelerators, coming from the process $\nu + n \rightarrow B \rightarrow p + e^-$, where $B \geq 2300\ m_e$. If there is no resonance the cross section is approximately 10^{-39} cm^2. If there is an intermediate particle σ_R and the average cross section over an energy interval, Δ, which includes the resonance is $\bar{\sigma}_R = \sigma(2\pi^2/q)(M/\Delta)(1/g^2)$, this gives rise to an average cross section of about 10^{-34} cm^2 for an energy interval of about 100 Mev which includes resonance. (N.W.R.)

17732 THE QUANTUM MECHANICAL THREE-BODY PROBLEM. I. PRINCIPLES. H. Diehl, S. Flügge, U. Schröder, A. Völkel, and A. Weiguny (Institut für Struktur der Materie, Marburg a.d. Lahn, Ger.). Z. Physik, 162: 1-14(1961). (In German)

The three-body problem of quantum mechanics was treated in appropriate co-ordinates. These are, besides those of the center-of-mass, the distances between the three particles and three Eulerian angles, fixing in space the position of the triangle formed by the particles. The Hamiltonian can be simplified by introducing the usual angular momentum operators of a gyrating rigid body. The solution of the wave equation is discussed. Factorization into an angular part and a part depending on the particle distances only leads to certain linear combinations of such products. The angular parts have the well-known form of the representation coefficients D^L_{MK} of the three-dimensional rotational group. The parts depending on the distances may be derived from a system of differential equations coupling, in two spearate sets, either even or odd values of K for each given value of L. (auth)

17733 THE QUANTUM MECHANICAL THREE-BODY PROBLEM. II. NON-LINEAR TRIATOMIC MOLECULE. S. Flügge and A. Weiguny (Institut für Struktur der Materie, Marburg a.d. Lahn, Ger.). Z. Physik, 162: 15-20(1961). (In German)

The results of the preceding paper are specialized to three-atomic molecules in which the three atoms are allowed only small vibrations about their equilibrium positions. This restriction to the vibrational amplitudes makes a perturbation calculation suitable. A sketch of the zero order approximation is given, and it is shown, at least for a symmetrical molecule of the type AB_2, how the limiting case of the rigid body may be obtained for which there exist the well known formulas of Wang. (auth)

17734 THE THEORY OF THE ppμ MOLECULAR ION. S. Flügge and U. Schröder (Institut für Struktur der Materie, Marburg a.d. Lahn, Ger.). Z. Physik, 162: 28-33(1961). (In German)

By use of the variational method developed in the preceding paper of Diehl and Flügge, the binding energy and molecular parameters of the muon molecule ppμ were calculated. The vibrational amplitudes of the protons turn out to be much larger in comparison to their equilibrium distance than in the electronic molecule H_2^+. The equilibrium distance is about 40% larger than it would have come out from a simple two-center calculation with fixed nuclei. A dissociation energy of 211 ev was found; this value may be enlarged by something between 10 and 20 ev in consequence of plausible corrections. (auth)

17735 GENERAL RELATIVITY AND GRAVITATIONAL WAVES. J. Weber. Interscience Tracts on Physics and Astronomy. 10. New York, Interscience Publishers, Inc., 1961. 207p. Cloth, $4.50; Paper, $2.50.

A study of general relativity is presented. The foundations of the theory, the Riemannian geometry and tensor calculus required, the conservation laws, and the classical experiments are described. The theoretical and experimental aspects of gravitational radiation are examined. Unified field theories, Friedman's solution of the cosmological problem, the Hamiltonian formulation of general relativity, and quantization and spinors in general relativity are discussed. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

17736 (AEET/HP/Th-1) RADIOACTIVITY BUILD-UP IN REACTOR COOLANT WATER. D. V. Gopinath (India. Atomic Energy Establishment, Trombay). June 15, 1958. Revised Mar. 15, 1960. 20p.

A theoretical evaluation of the built-up radioactivity in reactor coolant water is presented. Expressions for the coolant activity for various cases in different cooling systems are derived. Tables for the characteristics of some of the major impurities in the coolant water and the activity build-up in the coolant by thermal neutron activation in some typical cases are included. (auth)

17737 (ANL-4843(Del.)) REACTOR ENGINEERING DIVISION SEMIANNUAL REPORT, DECEMBER 1, 1951 THROUGH MAY 31, 1952. (Argonne National Lab., Ill.). June 15, 1952. Decl. with deletions Feb. 23, 1960. Contract W-31-109-eng-38. 43p.

Reactor design and development studies included: work on the Argonne Research Reactor (CP-5); and feasibility studies steam-generating plutonium-producing reactors which are D_2O-moderated, natural uranium reactors contained in pressurized tanks. Work done in reactor research was devoted to: the CP-6 bond-testing program, consisting of leak testing of fuel slugs, temperature cycling of canned slugs, ultrasonic inspections of bonded area and applications of oil diffusion methods for determining cracks; water quality control experiments for CP-6 program; instrument loops for slug rupture detection; low-temperature corrosion of aluminum; radiation effects studies on type-347 stainless steel, type A Nickel, fatigue in springs, creep of constantan wire, and the stability of slurries; and determining disadvantage factors in a uranium–H_2O-graphite lattices. (B.O.G.)

17738 (ANL-6343) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT. (Argonne National Lab., Ill.). Mar. 1961. Contract W-31-109-eng-38. 86p.

Research and development activities are reported on EBWR, BORAX-V, ZPR-III, ZPR-VI, ZPR-IX, EBR-I, and EBR-II. Thermal- and fast-reactor safety studies are summarized. Applied nuclear and reactor physics, reactor fuels development, reactor materials development, reactor components development, heat engineering, separations processes, and advanced reactor development are discussed. (M.C.G.)

17739 (CF-54-7-5) REFLECTOR-MODERATED-REACTOR DESIGN PARAMETER STUDY. PART I. EFFECT OF REACTOR PROPORTIONS. C. S. Burtnette, M. E. LaVerne, and C. B. Mills (Oak Ridge National Lab., Tenn.). Nov. 8, 1954. Decl. Mar. 22, 1961. 39p.

Geometrical effects on the criticality of the RM-CF (Fireball) reactor are calculated by a multiregion, multigroup method developed for solution by UNIVAC. Physical quantities such as U concentration in the fuel mixture, critical mass, etc., were calculated as a function of core radius, fuel thickness, and reflector thickness. (K.S.)

17740 (CF-60-3-159) INTERIM REPORT TO OAK RIDGE NATIONAL LABORATORY RELATING TO A DIGITAL DATA ACQUISITION SYSTEM FOR USE WITH THE HOMOGENEOUS REACTOR TEST FACILITY. R. K. Adams, G. H. Burger, C. A. Pfretzschner, and S. T. Schy (Thompson Ramo Wooldridge Products Co., Beverly Hills, Calif.). Mar. 29, 1960. 146p.

A description is given of the findings of a survey of the HRE-III, which was conducted: to define the useful function which could be performed by an on-line computer system; to describe the equipment requirements; and to present figures for determining the installation costs of the computer system. (B.O.G.)

17741 (CNEN-22) ON THE CALCULATION OF THE BARE REACTOR EXTRAPOLATION DISTANCE BY TWO-GROUP THEORY. V. C. Boffi and V. G. Molinari (Italy. Comitato Nazionale per L'Energia Nucleare, Ispra). Dec. 1960. 11p.

Some questions connected with the application of the method of effective boundary conditions in the frame of two-group diffusion theory are discussed. The well-known formula for the extrapolation distance of a bare reactor, given by Spinrad, is extended to both spherical and cylindrical geometries. (auth)

17742 (CRRP-985-A) EXPERIMENTAL EFFECTIVE FISSION CROSS SECTIONS AND NEUTRON SPECTRA IN A URANIUM FUEL ROD. PART I. NRX URANIUM METAL RODS. C. B. Bigham and P. R. Tunnicliffe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1961. 95p. (AECL-1186).

The radial variation of fission rates in U^{233}, U^{235}, and Pu^{239} were measured in an NRX rod for two values of fractional epithermal neutron intensity. Cadmium ratios of manganese and indium were obtained. From comparison with calculations and from supporting measurements in the surrounding moderator it is concluded that an excess of neutrons in the region of 0.3 ev over the conventional dE/E model of the slowing down spectrum must be considered. The effective temperature of the thermal component appears to be slightly above the moderator temperature; the temperature excess is probably related to the epithermal intensity. The light water coolant in NRX and its temperature affects the neutron spectrum. (auth)

17743 (HW-63072) TWO-GROUP, SMALL SOURCE THEORY APPLIED TO AN INFINITE ARRAY OF REACTOR SUPER-LATTICES. J. R. Worden (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 25, 1960. Contract AT(45-1)-1350. 36p.

A method of calculating the spatial distribution of the neutron flux in a heterogeneous reactor composed of parallel fuel elements with a complex lattice array by means of a small source theory is discussed. The technique provides for normalizing directly to experimental flux traverses in the uniform array so that the accuracy of calculations of changes in reactivity as the result of changes in the lattice configuration is increased. The necessity of knowing experimental flux traverses within the fuel regions was eliminated. The formulation of the theory is given together with applications to both simple and complex lattice arrays. (M.C.G.)

17744 (HW-6461(Rev.)) TEMPERATURE DISTRIBUTIONS OF REACTOR FUEL ELEMENT END CAPS. K. R. Merckx (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1961. Contract AT(45-1)-1350. 15p.

The temperature distributions within plate or thin tubular fuel elements with bonded end closures are determined with an eigenfunction expansion. A one term approximation is given for end caps longer than the plate thickness. Numerical examples are included for uranium fuel elements with

Zircaloy cladding and bonded Zircaloy end caps whose lengths are twice, once, and one-fifth the thickness of the fuel plate. For these examples, the ratios of the maximum exterior end cap temperature to the maximum temperature of the fuel material (coolant temperature considered as the base temperature) were: 0.38 for the end cap length to fuel plate thickness ratio of two; 0.68 for the end cap length to fuel plate thickness ratio of one; and 0.954 for the end cap length to fuel plate thickness ratio of one-fifth. (auth)

17745 (IDO-16668) REACTOR PHYSICS STUDIES FOR THE FINAL CONCEPTUAL DESIGN OF THE ADVANCED TEST REACTOR. R. S. Marsden, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 24, 1961. Contract AT(10-1)-205. 193p.

A detailed account of the reactor physics studies for the final conceptual design of the Advanced Test Reactor is presented. The diffusion theory methods used for calculations of flux distributions and reactivity effects are described and compared with measurements and with higher order approximations to transport theory. These comparisons show diffusion theory to be adequate for the ATR conceptual design. Two-dimensional flux distributions for a number of shim control conditions and experimental loadings were determined by PDQ-3 and TRANSAC-PDQ. The worths and effects on flux distributions of chemical and of blade type mechanical shim controls were compared. The effects of heavy water and of beryllium reflectors on reactivity and flux pattern were calculated. The time-dependent behavior of the reactor was investigated by use of TURBO and CANDLE. The changes in shim control poison and test and core flux distributions with fuel burnup were calculated and the full-power cycle time estimated. An investigation was made of the xenon transient after a full-power shutdown and recovery. Results of one- and two-dimensional fuel depletion studies are compared. The results of a number of time independent one-dimensional calculations and parametric studies are presented. Some comparisons were made of the results for one-dimensional and two-dimensional models of the ATR. The void coefficient of reactivity was found for the core, reflector, experiment, and flux trap regions of the reactor. Calculations of the temperature coefficient for the entire reactor and for individual regions were determined for one- and two-dimensional models. Xenon instability was studied for oscillations around one lobe, between lobes, and along the vertical axis. TURBO and CANDLE calculations were used to determine the effects of perturbations on the axial stability. An analytic method for determining axial stability was derived and applied to a single lobe model of the ATR. A perturbation technique was used to find the effects of reflector type and poisoning on the average core neutron lifetime. Calculations of the approximate lifetime of the delayed group from the reflector were made for a number of reflector conditions. Plots and tables of the gamma heat distribution in the ATR as determined by an IBM-704 program are presented. (auth)

17746 (LAMS-2531) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING FEBRUARY 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Mar. 1961. Contract W-7405-eng-36. 26p.

The LAMPRE-I project is summarized in terms of capsule development and production, sodium system, cover gas system, capsule charge, shielding, and fuel storage facility. The loading of the LAMPRE-I core was begun on January 20, 1961 with the sodium temperature set at 160°C. The reactor was brought to criticality on February 17, 1961. Operation of the Sodium Test Facility was continuous except for 6 maintenance and inspection shutdowns resulting in 680 idle hours. The intermediate sodium heat exchanger, steam generating unit, centrifugal sodium pumps, sodium flow control valves, and gas-fired sodium heater are discussed. Heat transfer test results are given for the various components. Research and development activities for the LAMPRE program are reported in the topics fuel and alloy program, container alloy development, direct contact core studies, development of liquid fuels, container materials for reactor fuels, and fuel reprocessing. (M.C.G.)

17747 (MND-E-2416) ANPP NUCLEATE BOILING PROGRAM. Quarterly Progress Report No. 3, December 1960—February 1961. C. Eicheldinger (Martin Co. Nuclear Div., Baltimore). Mar. 1961. Contract DA-44-192-ENG-6. 33p.

A plan was developed concerning the method of data reduction to be employed when the experimental PM-1 reactor simulation program is initiated. Fabrication of one complete test section assembly was completed. Tests are described for flow calibration, bulk coolant thermocouple response, and wall thermocouple tests. Instrumentation is also discussed. (D.L.C.)

17748 (NAA-SR-Memo-2559) DESCRIPTION OF A FLOW CONTROL SYSTEM INTENDED TO MAINTAIN FULL POWER REACTOR OPERATION IN THE EVENT OF SHUTDOWN OF "m" PUMPS. N. Kallay (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 21, 1958. 23p.

A fully automatic, quick acting flow control system designed to maintain full coolant flow through the reactor without requiring valve motion of any type for its operation is described. The closing of a manually operated, nonzero leakage blocking valve is only necessary as a prelude to removing a pump for maintenance while the reactor would continue to operate at full power. The proposed scheme utilizes presently available components only. (auth)

17749 (NDA-2147-3) A STATUS REPORT ON REACTIVITY COEFFICIENTS IN FAST REACTORS AND METHODS OF INVESTIGATING THEIR EFFECTS ON REACTOR STABILITY. J. Agresta (Nuclear Development Corp. of America, White Plains, N. Y.). Mar. 1, 1961. Contract AT(30-1)-2303 (XIII). 19p.

Methods for predicting the stability of fast reactors in the presence of both positive and negative reactivity coefficients are surveyed. Experimental methods of determining reactor stability are reviewed: excursion, transient, and oscillator. Sources of reactivity coefficients are discussed for both zero power and nonzero power operation. Representative reactivity coefficient values are presented, and positive coefficients due to Doppler effect, fuel bowing, and sodium coolant expansion are discussed. (D.L.C.)

17750 (TID-11859) THE USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS. Quarterly Report No. 1 for Period July 15 to October 15, 1960. (Societé Belge pour l'Industrie Nucleaire. Brussels and France. Commissariat a l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). EURATOM Contract 027-60-RDB. EURATOM/U.S.A. Agreement Proposal No. 0013. 143p. (Includes original, in French, 41p.) AEC 129/Euratom 13

Apparatus was constructed for the studies of precipitates formed with nitrates of calcinable salts and for recycling and analysis. This apparatus was tested with uranium. Two methods for the densification of UO_2 powders being examined are arc fusion and resistance fusion. Fabrication of spherical particles of UO_2 by mixture with a solution of camphor or alcohol in water and then screening was carried out. Simultaneous studies are being carried out on

methods of compacting UO_2 and PuO_2 by vibration and swaging. Co-reduction and fusion of Nb–Zr alloys were studied. Efforts to make powders from these alloys proved successful. The co-reduction of UO_2–MoO_3 with carbon was carried out in an attempt to fabricate non-pyrophoric, γ-uranium. The following procedure was adopted for dispersion shaping: mixing the dispersed and dispersing phases, compression of the mixture, and swaging the pellet after it is sheathed. An apparatus was constructed which will allow measurement of the specific heat of ceramic fuels based on the heat content per unit/mass. A study of the reaction $Zr(\beta) \rightarrow Zr(\alpha) + Zr(\beta)$ was carried out between 380 and 600°C. Corrosion of Zr–Nb alloys was investigated to 300°C. The mechanical properties of scattered fuel elements were investigated. (M.C.G.)

17751 (VDIT-33) PRESSURE TUBES FOR NUCLEAR REACTORS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). 1960. 5p.

Recent publications referring to pressure tubes for nuclear reactors are listed with accompanying summaries. (11 references) (J.R.D.)

17752 (WADD-TR-60-391) USE OF ANALOG COMPUTER TO SOLVE PROBLEMS OF NONUNIFORMLY LOADED NUCLEAR REACTORS. Irving A. Peltier (Wright Air Development Div. Propulsion Lab., Wright-Patterson AFB, Ohio). Sept. 1960. Project No. 3161. 28p. (AD-247180)

Use of analog computers to solve problems in which nuclear reactor cores are nonuniformly loaded with fuel, moderator, and structural material was studied. Analog circuits could be devised whereby approximate solutions to the neutron diffusion equation could be plotted and interpreted. However, the accuracy of the approximate solutions depends greatly on the complexity of the problem and the engineering applied. Special circuitry, which would simplify the problems and reduce calculations, would be inexpensive and could be constructed as a separate unit. (auth)

17753 (WCAP-1428) MULTI-REGION REACTOR LATTICE STUDIES. Quarterly Progress Report, October 1 to December 31, 1960. Ira H. Coen (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Jan. 30, 1961. Contract AT(30-1)-2176. 81p.

Results are reported for an extension of critical experiments and analyses which was made in the program for evaluation of water-moderated multiregion cores to study the discrepancy between calculated and experimental values of ρ^{28} (resonance capture/thermal capture ratio in U^{238}) and δ^{25} (resonance fission/thermal fission ratio in U^{235}). (auth)

17754 ALLOWANCE FOR MUTUAL SCREENING IN A SOLID LATTICE. N. I. Laletin. Atomnaya Energ., 10: 267-9(Mar. 1961). (In Russian)

The magnitude P_c, expressed by the integral

$$P_c = \int_{V_2} \frac{\Sigma_2 dV}{V_2} \int_{V_2} \frac{dV'}{4\pi} \frac{e^{-\int_r^{r'} \Sigma(r'')dr''}}{[r-r']^2}$$

is used for calculating fast neutron breeding in heterogeneous reactors. The effects of inelastic scattering on neutron slowing down, on heat transfer in radiation absorption, etc., is combined with the magnitude P_1, expressed by the integral

$$P_1 = \int_{V_2} \frac{\Sigma_2 dV}{V_1} \int_{V_1} \frac{dV'}{4\pi} \frac{e^{-\int_r^{r'} \Sigma dr''}}{[r-r']^2}$$

(where V_1 is the volume of the moderator), for calculating the mutual shielding in a slab lattice. The magnitudes $X_1 = 4\Sigma_1 v_1/S$ (the mean distance between slabs v_1 is the moderator volume per slab); and $X_2 = 4\Sigma_2 v_2/S$ (the hydraulic diameter measured as the neutron free path, S is the slab surface area) are derived, and an integral equation is developed for neutron interactions in heterogeneous reactors. Values were determined for P_c cyl. for X_1 and X_2 = 0.2, 0.4, 0.6, 0.8, 1.2, 1.6, 2.0, 3.0, 4.0, 6.0, 8.0, and ∞. (R.V.J.)

17755 THE EFFECTIVENESS OF A SET OF CONTROL RODS ARRANGED SYMMETRICALLY IN A RING IN THE CORE OF A REACTOR WITH A REFLECTOR. V. I. Nosov. Atomnaya Energ., 10: 269-70(Mar. 1961). (In Russian)

Calculations were made for large-dimension control rods distributed symmetrically around the active zone of a reactor with a reflector. The control rods represent a thin container filled with active zone material. It is assumed that the container is absolutely black for thermal neutrons but neither absorbs nor slows down the fast neutrons. The control element radii are calculated for various approximations, and efficiencies of three-element systems are plotted as functions of radius in $\underline{k}$ approximation ($\underline{k}$ is the index of sums considering the azimuthal dependence of neutron flux on the surface of control elements). (R.V.J.)

17756 ELECTRONIC SIMULATOR OF NUCLEAR REACTORS. [PART] I. Mario Pizarro Aguilar. (C.E.A., Lima). Bol. inform. junta control energía atómica (Peru), 6: No. 31, 39-54(Jan.-Feb. 1961). (In Spanish)

The general considerations governing an electronic reactor simulator are reviewed. Prompt and delayed neutrons in reactor dynamics are first considered. The simultaneous differential equations for the dynamics of fission in the presence of delayed neutrons are derived. (J.S.R.)

17757 THE BACKGROUND NOISE OF NUCLEAR REACTORS. A SIMPLE RADIO-ELECTRIC MODEL. Augustin Blaquiere and Roza Pochowska. Compt. rend., 251: 2918-20(Dec. 19, 1960). (CEA-1838) (In French)

A new method is given for studying the neutronic background noises of nuclear reactors. From it a simple radioelectric model is developed which makes it possible to obtain rapidly the mean square of the density fluctuations and the distribution of the noise frequencies. (auth)

17758 STEAM FORMATION AND ITS EFFECT IN LIQUID COOLING REACTORS. Hajnal Albert. Energia es Atomtech., 14: 84-96(Feb. 1961). (In Hungarian)

A review article is presented discussing the present state of knowledge on the problems presented by the boiling of water in the various types of boiling water reactors. The importance of bubble formation, nucleate boiling and heat transfer are reviewed while discussing the differences between reactors cooled by high-pressure liquids, by boiling water, by water-steam mixtures and by steam. Operational instability, bubble dynamics, and macroscopic thermodynamic processes in reactors are considered with special attention to the danger arising from the replacement of water by steam near the tube walls. Variation of the heat transfer coefficient as a function of the water–steam ratio are also presented. It is concluded that this system of cooling is very promising but requires additional studies for solving hydro- and thermodynamic problems. (TTT)

17759 PHYSICAL CONSIDERATIONS ON THE INTRODUCTION AND APPLICATION OF NEUTRON SOURCES IN REACTORS. H. A. Sandmeier (Argonne National Lab., Ill.). Kerntechnik, 3: 128-30(Mar. 1961). (In German)

Neutron source strength for given positions of neutron sources and the smallest detectable neutron flux in subcritical reactors are calculated. (tr-auth)

17760 CALCULATION OF PARAMETRIC INFORMATION FOR FAST REACTORS. R. E. Reid. Nuclear Energy, 158-60; 164(Apr. 1961).

A first-order perturbation method is developed for reducing computer time of transport theory calculations; the method is designed for small fast reactors, with or without reflectors. The method calculates the flux and adjoint simultaneously from their respective transport equations, and solves for the desired eigenvalue in an action that eliminates first-order errors. The method is outlined for a SNAP-type or ZPR-III reactor. (T.F.H.)

17761 SORPTION OF FISSION PRODUCT IODINE FROM AIR ON DIFFERENT MATERIALS WITH APPLICATION TO NUCLEAR REACTOR ACCIDENTS. Sevald Forberg (Royal Inst. of Tech., Stockholm), Torbjörn Westermark, and Carl-Eric Holmquist. Nukleonik, 3: 31-41 (Mar. 1961). (In English)

The major role exerted by I^{131} on the environmental hazards around a reactor site is explained, and the importance of the iodine sorption characteristics of the reactor containment is stressed. Three types of investigations on iodine sorption are employed. The competing sorption on different plastics, concrete, and rock was investigated in order to evaluate the suitability, from an iodine point of view, of coating materials in a reactor station. During the first minutes of exposure, the acrylic and epoxy resins showed the highest uptake rate but, after longer exposures, concrete totally outclassed all other materials. The efficiency of crushed concrete beds as a trap for gaseous iodine was determined, and the half-length values of the iodine concentration in the flowing air were found to be smaller than 1 cm. Ion exchange resins were found to be very useful as iodine sorbents. The sorption of iodine from air flowing through rock fissures was investigated, and a very high decontamination factor was indicated from the results of these experiments and actual measurements on leaking velocities from a rock cavity. (auth)

17762 OPTIMUM OPERATING CONDITIONS OF PILE OSCILLATOR. Witold Suwalski and Zbigniew Weiss (Inst. of Nuclear Research, Academy of Sciences, Warsaw). Nukleonika, 6: 1-16(Jan. 1961). (In Polish)

A stationary method of evaluation of the expected sensitivity of a pile oscillator as well as the determination of the most favorable conditions of its operation is worked out. This method allows the determination of the possibilities of a given reactor. Three main types of oscillators are discussed. In the case of the third type the knowledge of the mean life time of neutrons is necessary. As an illustration the parameters of the Chatillon oscillator are compared with the measured expected sensitivity of a similar oscillator which was intended to work on the reactor "EWA". (auth)

17763 ON INFLUENCE OF ANISOTROPIC SCATTERING ON CRITICALITY OF A MULTIPLYING SPHERE. Yu. S. Sigov. Vestnik Moskov. Univ., Ser. III, Fiz. Astron., 15: No. 4, 79-85(June-Aug., 1960). (In Russian)

A generalized Carlson method is used for evaluating the influence of anisotropic scattering on the critical radius and spatial neutron flux density distribution in homogeneous, spherical fast reactors without reflectors. The results derived by the transport equation and by the developed method are correlated. An attempt was made to determine the applicability limits of transportation approximation. (R.V.J.)

17764 NUCLEAR REACTOR THEORY. Proceedings of Symposia in Applied Mathematics. Volume XI. Proceedings of the Eleventh Symposium in Applied Mathematics of the American Mathematical Society, Held at the Hotel New Yorker, April 23-25, 1959. Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961. 344p.

Nineteen papers were presented. Mathematical aspects of reactor theory were stressed. Topics covered included transport theory, multigroup diffusion theory in 1-, 2-, and 3-space, numerical methods (including Monte Carlo), radiation attenuation problems, and low- and high-power reactor kinetics. Seventeen of the 19 papers are covered by separate abstracts. Two were previously abstracted in Nuclear Science Abstracts. (T.F.H.)

17765 REACTOR TYPES. Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). p.1-19 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

The general makeup of reactors is described. The kernel and Boltzmann forms for reactor theory are considered; the energy, spatial, and angular dependences of the neutron fluxes are examined; and the time behavior of reactors is discussed. Applications of mathematics to reactor theory are suggested. (T.F.H.)

17766 NEUTRON THERMALIZATION. M. S. Nelkin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.20-42 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961. (GA-746)

The thermalization of neutrons to energies below ~1 ev is studied. The importance of the energy transfer cross section $\sigma(E_0,E,\Theta)$ is stressed, for energy transfer $E_0 \rightarrow E$ through an inelastic scattering angle Θ. Spatial independence of the slow neutron spectrum is assumed. Values of $\sigma(E_0,E,\Theta)$ for various moderators are considered in terms of explicit models; spectra calculated from the models are presented and compared with experimental data when possible. A discussion of spatially dependent spectra is given. (T.F.H.)

17767 DEEP PENETRATION OF RADIATION. U. Fano and M. J. Berger (National Bureau of Standards, Washington, D. C.). p.43-57 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Deep penetrations of neutrons and γ rays into an infinite homogeneous isotropic medium are studied. The penetration obeys a linear transport equation; that is, the energy is lost in small steps. A combined physical, analytical, and numerical method is used to solve the transport problem. The method applies both to single kinds of radiations and to cascades. (T.F.H.)

17768 THE THEORY OF RESONANCE ABSORPTION. L. W. Nordheim (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.58-88 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Methods are given for calculating resonance capture from known resonance data, for almost all geometries and temperatures, especially in reactors. The problem is formulated for homogeneous and heterogeneous geometries; it is shown that the flat-flux assumption must be made to solve the heterogeneous case. A simple numerical method for solution of the slowing-down equations is given. Ap-

proximations in resonance integral calculations are summarized. Calculated and observed resonance integrals are compared for U^{238} and Th^{232}. (T.F.H.)

17769 MATHEMATICAL PROBLEMS OF NUCLEAR REACTOR THEORY. Eugene P. Wigner (Princeton Univ., N. J.). p.89-104 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

The mathematical problems of reactor theory are divided into 2 classes. The first class concerns the mathematical theory of and approximations to the basic transport equations. For instance, the multiplication and criticality equations are not normal characteristic value equations because their operators do not belong to the class for which the characteristic value theory is well established. The character and properties of the highest characteristic value and the corresponding characteristic vector are known, but the properties of the lower characteristic values and vectors are not known. In particular, the extent of a continuous spectrum and the completeness of the whole set of characteristic vectors are not established in general. A simple example is given in which the transport operator has a continuous spectrum that is not observed experimentally. A generalization of the characteristic value problem is proposed. The second class of problems is concerned with methods for obtaining solutions of the reactor equations, such as the methods of coding the equations for calculating machines. Other methods are described, among which the transformation of the reactor equations into a variational principle proves most effective. This transformation is also carried out only for the most simple problems and it is not known whether all problems of reactor theory can be reformulated as variational problems. A reformulation of diffusion theory is discussed that sometimes gives more accurate results than the conventional theory. (auth)

17770 DIFFUSION APPROXIMATION TO THE TRANSPORT EQUATION. J. Ernest Wilkins, Jr. (Nuclear Development Corp. of America, White Plains, N. Y.). p.105-15 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

The so-called multigroup diffusion equations are derived from first principles, in order to gain an understanding of the restrictions implied by the use of these equations. The use of these equations in reactor design is discussed. Mention is made of some of the generalizations and extensions of these equations which are occasionally used for the more refined calculations appropriate in the later stages of a reactor design. (T.F.H.)

17771 POSITIVITY AND CRITICALITY. Garrett Birkhoff (Harvard Univ., Cambridge, Mass.). p.116-26 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

The concept of positivity is used systematically to provide a mathematical basis for the concepts of criticality, multiplication factor, period, principal distribution, and importance function in nuclear reactor theory. Rigorous existence theorems are given for these related concepts. (T.F.H.)

17772 EXISTENCE THEOREMS AND SPECTRAL THEORY FOR THE MULTIGROUP DIFFUSION MODEL. G. J. Habetler and M. A. Martino (Knolls Atomic Power Lab., Schenectady, N. Y.). p.127-39 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

The existence and uniqueness of solutions to the multigroup diffusion equations, of a normalized positive eigenfunction (the fundamental mode), and of this eigenfunction's corresponding adjoint eigenfunction (the importance function) are proved for finite reactors. Both the time-independent and time-dependent problems of the multigroup diffusion model are considered. A discrete space approximation yields a set of algebraic equations, which are adaptable to numerical methods. (T.F.H.)

17773 ONE-DIMENSIONAL MULTIGROUP CALCULATIONS: ESTIMATION OF GROUP CONSTANTS. R. Ehrlich (Knolls Atomic Power Lab., Schenectady, N. Y.). p.151-63 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Problems associated with reactor diffusion theory in 1-space dimensions are described. One-dimensional calculations are used for surveying broad ranges of reactor parameters and as aids in normalizing and interpreting higher dimensional calculations. Uses of these 1-space calculations in reactor computer methods are noted. A method is given for estimation of the group constants that are parameters in difference equations derived by the 1-space multigroup analysis. (T.F.H.)

17774 NUMERICAL METHODS FOR SOLVING MULTIDIMENSIONAL MULTIGROUP DIFFUSION EQUATIONS. Richard S. Varga (Westinghouse Electric Corp., Pittsburgh). p.164-89 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Available numerical methods for solving the n-dimensional ($1 \leq n \leq 3$) reactor multigroup diffusion equations are examined. Both the rigorous mathematical features and practical applications of these numerical methods are shown for both time-independent and time-dependent diffusion equations. Methods used in existing codes for high-speed digital computers are stressed. (T.F.H.)

17775 MONTE CARLO METHODS. R. D. Richtmyer (New York Univ., New York). p.190-205 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Applications of the Monte Carlo method to reactors are discussed, including calculations of neutron evolutions, resonance capture probabilities in lattices, and shielding penetrations by γ rays and neutrons. Methods of random number generation and of sampling are surveyed; advanced sampling methods for specialized uses are noted. The total absorption is calculated for the case of a H_2O-moderated hexagonal lattice of UO_2 fuel rods. (T.F.H.)

17776 TRANSPORT THEORY AND INVARIANT IMBEDDING. Richard Bellman and Robert Kalaba (RAND Corp., Santa Monica, Calif.). p.206-18 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

The theory of invariant imbedding is applied to 1-dimensional neutron multiplication problems. It is shown that

some of these problems, particularly critical length (mass) problems, can be reduced from eigenvalue problems to initial-value problems that are suited to computer solution. Time-independent and time-dependent processes, angular dependence problems, and multigroup processes are discussed. (T.F.H.)

17777 NUMERICAL SOLUTION OF NEUTRON TRANSPORT PROBLEMS. Bengt Carlson (Los Alamos Scientific Lab., N. Mex.). p.219-32 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

A numerical method, the "discrete S_n" method, for solution of the neutron transport equation is described; the discrete S_n method is a simplification of the original S_n method. The use of this method in solution of the transport equation for an isotropic multigroup system is shown. The method can be programmed for computer use. (T.F.H.)

17778 PROBLEMS OF REACTOR KINETICS. Harry Soodak (City Coll., New York). p.233-55 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Low power reactor operation is considered. Stochastic aspects of reactor kinetics are discussed; it is shown that these aspects are usually important only during slow start-ups, when neutron populations are small. Reactor modes and their excitations are described. One-parameter equations to describe reactors are given. The prompt neutron jump approximation is studied. Feedback, stability, perturbations, and problems of non-linearity are considered. The adjoint function, neutron importance function, reactivity, and multiplication constant are investigated for bare homogeneous reactors. (T.F.H.)

17779 CORE KINETICS. H. L. Garabedian (General Motors Corp., Detroit). p.256-88 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Low power reactor core kinetics are discussed for inhomogeneous and reflected reactors. The generalized kinetic equations are derived that are encountered in transitions from bare homogeneous reactors to inhomogeneous reactors. Problems encountered in finding space-independent solutions of these equations for bare homogeneous reactors are described. Difficulties in finding space-dependent solutions of a special form of the kinetic equations are also described. Analytic, rather than computer methods, are stressed. (T.F.H.)

17780 TEMPERATURE COEFFICIENTS AND STABILITY. Harvey Brooks (Harvard Univ., Cambridge, Mass.). p.289-308 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Kinetics of reactor operations are considered, at high power outputs sufficient to induce feedback. Three general classes of problems are studied. Small oscillations are examined, for which the kinetic equations can be linearized. Larger oscillations are also examined, in which feedback destroys the linearity of the kinetic equations, but which are non-destructive to the reactor. Finally, large excursions are studied, in which permanent changes take place in the reactor; the self-limiting features of such excursions are investigated, in connection with reactor hazard analyses. (T.F.H.)

17781 SYSTEM KINETICS. T. A. Welton (Oak Ridge National Lab., Tenn.). p.309-26 of "Nuclear Reactor Theory. Proceedings of Symposia in Applied Mathematics. Volume XI." Garrett Birkhoff and Eugene P. Wigner, eds. Providence, American Mathematical Society, 1961.

Thermal and acoustical instabilities in operating reactors are studied. The thermal instabilities refer to low frequency reactor power excursions, and the acoustical instabilities refer to normal high frequency acoustical oscillations of the system. Instabilities because of turbulent fluid flow are noted. (T.F.H.)

17782 NUCLEAR REACTOR CONTAINMENT BUILDINGS AND PRESSURE VESSELS. Proceedings of a Symposium, The Royal College of Science and Technology, Glasgow, Scotland. London, Butterworths, 1960. 578p. $18.50.

Twenty-four papers are presented, with discussions and summaries. Topics covered include the analysis, design, construction, and testing of containment buildings and pressure vessels used in nuclear power plants. Separate abstracts have been prepared for all twenty-four papers. (T.F.H.)

17783 THE CALL FOR DEVELOPMENT IN PRESSURE VESSELS AND CONTAINMENT BUILDINGS FOR NUCLEAR REACTORS. S. Fawcett (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.3-18 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

A general survey is given of reactor vessels and containment buildings for current reactor systems. Systems under study currently are outlined; bases for vessel and containment building specifications are described. Advances in pressure vessel technology are suggested. (auth)

17784 THE DESIGN AND SPECIFICATION OF PRESSURE VESSELS AND CONTAINMENT BUILDINGS IN A NUCLEAR POWER PROJECT. G. Brown (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.19-37 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

The presence of radioactive fission products in fuel is the major hazard associated with reactor operation. In the event of failure of the fuel cans these products must be contained. The containment is provided by the reactor vessel and its associated primary circuit including heat exchangers and circulators. In certain reactor systems and with particular sites it is necessary to have a further line of defense, and the primary circuit is then housed within a containment building. The design and the functional and engineering specifications of these 2 "pressure vessels" are considered. Particular attention is given to the design of the reactor vessel. (auth)

17785 BASIC SAFETY CRITERIA FOR NUCLEAR RE ACTOR CONTAINMENT. B. E. Eltham (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.38-49 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

The effects of radiation and the order of biological hazard associated with nuclear reactors are discussed. These are considered in relation to reactor siting, integrity of containment, and inspection. (auth)

17786 REINFORCED CONCRETE AS A MATERIAL FOR CONTAINMENT. T. C. Waters (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.50-60 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

The merits and defects of reinforced concrete in large reactor containment buildings by itself, or in combination

with a gas-tight membrane are discussed, and suggestions are offered for items demanding further research and study in the solution of this problem. It is concluded that the consideration of concrete as a medium for gas containment calls for a consequent lowering of the temperature, pressure, and perhaps the level of gas-tightness currently imposed upon the containment building. (auth)

17787 DESIGN OF STEEL CONTAINMENT VESSELS IN THE U.S.A. L. P. Zick (Chicago Bridge & Iron Co., Chicago). p.91-113 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Most large nuclear reactors being constructed in the U. S. A. currently use pressure-tight steel containment vessels to house nuclear reactors and certain associated equipment. Experience to date is reviewed, pointing out the requirements of existing and proposed Codes applicable to these special vessels. The present pattern indicates that one of three basic shapes usually applies depending primarily upon the pressure–volume requirement. Structural design aspects of these large relatively thin pressure vessels are outlined assuming that the pressure and temperature resulting from the maximum credible accident have been specified by the nuclear designer of the plant. Features are described for accessories such as air locks and penetrations and for methods of inspection and testing. (auth)

17788 CONTAINMENT STUDIES OF THE ENRICO FERMI ATOMIC POWER PLANT. W. McGuire and G. P. Fisher (Cornell Univ., Ithaca, N. Y.). p.114-33 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

An engineering analysis is presented of the ultimate containment capability of the Fermi Fast Breeder Reactor plant. The nuclear excursion considered is assumed to resemble in amount and rate of energy release the detonation of a 1,000 lb. charge of conventional high explosive. It is shown that while extensive internal disruption is to be anticipated, the outer containment vessel, as designed, will be capable of containing all the effects considered without deforming plastically. (auth)

17789 STRESS ANALYSIS PROBLEMS ASSOCIATED WITH THE DESIGN OF REACTOR PRESSURE VESSELS. R. W. Bailey and R. Hicks (General Electric Co., Ltd., Erith, Kent, Eng.). p.134-49 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Methods of analysis are described for various stress problems encountered in the design of pressure vessels for gas cooled natural uranium reactors. In particular, consideration is given to the stresses induced in a spherical pressure vessel due to the constraining effect of a cylindrical skirt. The skirt is taken as being made of 2 sections having different thicknesses, one section being located inside the vessel and the other directly underneath on the outside of the vessel. In general, the magnitude of these stresses depends on the relative thicknesses of the components of the structure joined at the discontinuity as well as the pressure in the vessel, the weight of the core, and any temperature variation in the structure at the point of support. The magnitude of the induced stresses is given for different types of loading when the thicknesses of the inner and outer skirts are equal. Using well known theories for shallow shells, a method is shown for determining the stress distribution around line loads applied to spheres. A practical case of this type of loading occurs at Hunterston where the reactor sphere is supported on a series of radial gussets lying in meridional planes and located at the top of a cylindrical skirt. To illustrate the method of analysis, the particular case of a radial load and moment applied to a sphere through a gusset is considered numerically, and the results are used to show the attenuation of the bending moments and membrane forces in the sphere in the area in the vicinity of the gusset. (auth)

17790 THE STRESS ANALYSIS OF A CONTAINMENT VESSEL SUBJECTED TO LATERAL LOADS. F. A. Leckie and R. K. Livesley (Cambridge Univ., Eng.). p.150-63 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

A containment vessel and its supporting structure are analyzed under the action of lateral earthquake loading. The analysis is carried out by combining existing solutions of the equations of spherical and cylindrical shells in such a way as to satisfy the appropriate compatibility and equilibrium conditions. (auth)

17791 THE INFLUENCE LINE METHOD OF SHELL ANALYSIS. R. M. Kenedi (Royal Coll. of Science and Tech., Glasgow). p.164-73 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

A technique of stress and deformation analysis of shell forms readily adaptable to design use is presented. This technique is based on the experimentally substantiated assumption that the principle of superposition applies, permitting the introduction of the conventional influence line method of structural analysis to shell computations. Numerical examples showing the application of the technique to the analysis of spherical shells are included. (auth)

17792 DISCONTINUITY PROBLEMS IN SHELL STRUCTURES. D. S. Houghton (Coll. of Aeronautics, Cranfield, Bucks, Eng.). p.191-220 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Methods of solution are indicated for a number of discontinuity problems that are associated, in some form, with reactor containment vessels and aircraft pressure cabins. (auth)

17793 AN EXPERIMENTAL STUDY OF ATTACHMENTS TO CYLINDRICAL AND SHALLOW SPHERICAL SHELLS. E. T. Cranch and J. W. Dally (Cornell Univ., Ithaca, N. Y.). p.221-56 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

A series of tests are performed on a representative cylindrical shell to which are fastened five different attachments. Each attachment is loaded externally with a radial force, a longitudinal couple and a circumferential couple while strain and deflection readings are taken in the vicinity of each attachment. A second series of tests are performed using the same types of external loads but with the cylindrical shell pressurized to 193 lb./in.^{2}. The experimental and theoretical values of deflections and membrane and bending stresses are compared along the shell generator and meridian which intersect the attachment center-line. A third series of tests are performed on three representative spherical shells to which nozzles are fastened. Each nozzle is loaded with an axial force and bending couple while strains and deflections are recorded in the vicinity of each nozzle. In order to determine the effects of nozzle wall thickness, successive tests are made after boring out the nozzles. (auth)

17794 ELASTIC BUCKLING OF THIN SPHERICAL SHELLS. J. M. T. Thompson (Cambridge Univ., Eng.). p.257-85 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

The literature, and the present state of knowledge, of two elastic buckling problems are reviewed. The first problem is that of a complete thin spherical shell under uniform external pressure. The second problem is that of a segment of a thin spherical shell, clamped along its edge, and loaded under uniform external pressure. No other types of loading, or conditions of support, are considered. The important distinction between the two problems is that, in the unbuckled but loaded states, the complete spherical shell contains only membrane stresses, while the clamped segmental shell has bending stresses due to the edge support. (auth)

17795 ASYMPTOTIC SOLUTIONS FOR THE SPHERICAL SHELL SUBJECTED TO AXIALLY SYMMETRIC LOADING. F. A. Leckie (Cambridge Univ., Eng.). p.286-97 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

The integration of the differential equations of a spherical shell subjected to axially symmetric loading can be separated into two parts. The surface loading is assumed to be carried by the membrane action of the shell, the resulting membrane solution being a good approximation to the particular integral of the differential equations. The solutions of the homogeneous differential equations on the other hand, describe the effect of forces applied at the boundary of the shell. The discussion is limited to these homogeneous equations. (auth)

17796 AN EXPERIMENTAL INVESTIGATION OF THE BEHAVIOUR OF SHALLOW SPHERICAL DOMES SUBJECTED TO A VARIETY OF LOAD ACTIONS. A. S. Tooth (Royal Coll. of Science and Tech., Glasgow). p.298-315 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Shallow spherical shells with 3 R/t ratios are subjected to a variety of load actions. These load actions include radial area loads applied at the crown of the dome and at "off-set" positions; radial ring loads applied at the crown; and finally "bending" and "twisting" moment actions. The results are compared with theoretical analyses. In the case of the "twisting" moment action an approximate theory is developed and used as the basis of comparison. The experimental results substantiate the shallow spherical shell theory and imply that this may be used in developing design techniques. (auth)

17797 STRESS CONCENTRATIONS AT THE JUNCTION OF A SPHERICAL PRESSURE VESSEL AND CYLINDRICAL DUCT CAUSED BY CERTAIN AXI-SYMMETRIC LOADINGS. R. K. Penny (English Electric Co., Ltd., Whetstone, Leics, Eng.). p.347-68 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

A method for determining stresses at the junction of a cylinder with a spherical pressure vessel under some symmetric loading conditions is presented. The method, which consists of matching displacements of adjoining elements to the satisfaction of the equilibrium requirements, is applied to eight configurations. The first three of these consists of a photo-elastic model and scaled versions of this, while the remainder are typical of British nuclear reactor pressure vessels of current designs. For internal pressure loading agreement with the experimentally obtained maximum stress concentration factor is obtained. The effect of scaling test model dimensions is to increase stress concentration factors as radius to thickness ratios approach practical values. It is concluded that if reinforcing material is placed in the cylinder as well as in the vessel, smaller stress concentration factors will result than if the same material is placed in the vessel only. The approximations whereby regions of the vessel local to the opening are replaced by a flat plate, or the cylinder is treated as rigid, are not to be recommended in the design of cooling gas duct openings in nuclear pressure vessels. The first of these could lead to values of stress concentration factors optimistic by 50%, while the second gives roughly the correct magnitude of stresses in the wrong directions. (auth)

17798 CHARACTERISTIC EQUATIONS IN THE THEORY OF CIRCULAR CYLINDRICAL SHELLS. L. G. Jaeger and A. H. Chilver (Cambridge Univ., Eng.). p.369-78 "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Basic characteristic equations are derived for the boundary loading of thin circular cylindrical shells. For representation in a Fourier series circumferentially the roots are computed for a small number of geometrical parameters over a wide range of "thinness" of the shell. For representation in a Fourier series longitudinally, roots are already available. (auth)

17799 THEORETICAL INVESTIGATION OF THE BEHAVIOUR OF STEEL STRUCTURES AT ELEVATED TEMPERATURES, WITH PARTICULAR REFERENCE TO STRESS RELIEF OF THE HUNTERSTON REACTOR PRESSURE VESSEL. N. W. Murray and R. W. Bailey (General Electric Co., Ltd., Erith, Kent, Eng.). p.379-92 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Two methods that enable the behavior of steel structures at elevated temperatures to be studied are presented. In the first method creep curves are completely linearized and the concept of a creep surface is used. For the steel used it is possible to use a hyperbolic paraboloid as the creep surface and so obtain great simplification of creep phenomena. By choosing the constants that define the geometry of the hyperbolic paraboloid it is always possible to obtain conservative results. The method is illustrated with examples and one bending creep test. In the second method the creep curves are approximated by empirical laws and the effects of changes in the variables are obtained by integration. Again, examples are used to illustrate the application of this method. (auth)

17800 THERMAL STRESSES IN THIN-WALLED CIRCULAR CYLINDERS. D. J. Payne (English Electric Co., Ltd., Whetstone, Leics, Eng.). p.393-410 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Analytical and numerical methods are used to find the elastic stresses and deflections produced by temperature variations over the surface of a cylinder typical of those used to support the core of graphite moderated gas cooled reactors. The particular temperature distribution studied varies exponentially along the cylinder and sinusoidally around it. The symmetric and asymmetric parts of this temperature distribution are treated separately. A comparison of solutions for the symmetric distribution shows that the stresses obtained by fitting a polynomial equation and, by standard finite difference methods, using a net of one-sixteenth of the cylinder length, are within 10% of the exact solution. A method suggested by Richardson that improves the accuracy of the stresses found by the finite difference method to within 1% of the exact solution is also described. For the chosen asymmetric temperature

distribution, a particular integral of Flügge's equations is readily obtained. A more general method using Fourier series is also used to find a particular solution but, although only a single Fourier series is needed in this case, a considerable amount of computation is required to obtain a satisfactory solution. Hoff's method of solving Donnell's equations for the deflection of cylinder is sufficiently accurate to find a complementary function satisfying any boundary condition. An alternative solution by finite difference methods is attempted but although this method shows promise it needs further development before an acceptable solution is obtained. The reasons for this are discussed and suggestions regarding further work made. (auth)

17801 THE STEADY CREEP OF SHELLS: A METHOD OF ANALYSIS. C. R. Calladine (English Electric Co., Ltd., Whetstone, Leics, Eng.). p.411-31 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

After a discussion of creep in pressure vessels and of the advantages of considering the steady-creep state, a method of analysis of the behavior of the shell in this state is described. An expression is set up to describe the creep behavior of a shell element subject to arbitrary bending and direct stress resultants; the expression contains a single quadratic interaction expression in contrast to the more usual piecewise-linear expressions. A creep law is used in which strain rate depends on the third power of the stress. A finite-difference iterative method is described by which the shell equations, incorporating the results of the first part of the analysis, may be solved. As an example of the application of the method, the behavior of an unpressurized cylinder subject to arbitrary edge radial shear and axial bending moment is studied. The solution is compared to that for an elastic cylinder under similar loading. (auth)

17802 THE ENGINEERING DESIGN OF CONTAINMENT BUILDINGS FOR NUCLEAR REACTORS. N. T. Barrett (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.461-73 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

The design of a containment building requires a synthesis of operating requirements, guaranteed containment requirements, and practical limitations imposed by construction techniques. The finished design must be a compromise between requirements which are sometimes conflicting and in which economic considerations must play a part. Safety precautions must be economically judged if nuclear power has to compete with other forms of power. The major limitations imposed by plate thickness limits, methods of support, and access are outlined. Means of varying the containment system and the shape and size of the building to overcome these problems are suggested. It is concluded that the correct basic design of the building at an early stage in the design program is essential to permit the design of the remainder of the project to proceed. A contractor's detailed design needs to conform to this basic design if major changes to the other parts of the project are to be avoided. (auth)

17803 FABRICATION AND ERECTION OF HEAVY PRESSURE VESSELS FOR THE NUCLEAR ENGINEERING INDUSTRY. J. McLean and J. W. Thompson (Motherwell Bridge and Engineering Co., Ltd., Eng.). p.474-95 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Stages in the shop fabrication and welding of heavy cylindrical and spherical pressure vessels for the nuclear engineering industry are described, along with some of the problems associated with the site erection of these large vessels. (auth)

17804 AIR TESTING OF LARGE, SITE CONSTRUCTED, REACTOR PRESSURE VESSELS. A. C. Dearden and T. F. Brock (Lloyd's Register of Shipping, Croydon, Eng.). p.496-506 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Structural tests are described on certain reactor pressure vessels, which are constructed for the UKAEA Industrial Group and for the first nuclear power stations under construction for the Central Electricity Generating Board. The background to the tests and some results from them are described. (auth)

17805 ANALYSIS OF BRITTLE STRENGTH OF A REACTOR VESSEL. J. Nemec. p.521-31 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

Factors involved in the brittle strength of steel in nuclear uses are examined, including wall thicknesses, integral neutron fluxes, initial defect densities, stress concentrations, and magnitudes and frequencies of pressure and temperature changes. Conclusions are drawn as to the validity of testing methods and the complexity of the effects involved in brittle fracture. (T.F.H.)

17806 BRITTLE FRACTURE BEHAVIOUR OF METAL STRUCTURES. H. M. Schnadt. p.532-41 of "Nuclear Reactor Containment Buildings and Pressure Vessels." London, Butterworths, 1960.

A testing system for steels is derived from theoretical considerations. Stress states are described in this system in terms of principal stress, plastifying power, and anamorphy. It is concluded that the resistance of steels to brittle fracture can be tested only by striking very sharply notched bars, at veloganies from 4 to 6 and at all relevant temperatures. An apparatus is described for this type of testing. (T.F.H.)

17807 METHOD OF MEASURING THE PERIOD OF A NUCLEAR REACTOR. (to Zavody V. I. Lenina Plzen, Narodni Podnik). British Patent 865,552. Apr. 19, 1961.

A method for measuring the period of a reactor is described which is especially suited for full automation of reactor control. The method comprises the steps of (1) moving a detector in the reactor radiation field in such a way that the field intensity along the path decreases approximately exponentially, (2) subtracting the detector signal from a constant demand signal to provide a control signal, (3) controlling the detector movement to maintain the control signal at the smallest possible value, and (4) measuring the detector velocity as a quantity inversely proportional to the instantaneous value of the reactor period. The advantages of this method are that one apparatus serves both as a reactor power level meter and as a reactor period meter and no exponential check signals or complicated electronic circuits are required. (D.L.C.)

17808 GAS-COOLED NEUTRONIC REACTOR. (to U. S. Atomic Energy Commission). British Patent 867,454. May 10, 1961.

A refractory fueled nuclear reactor incorporating an active portion comprising a mass of solid refractory neutron moderator having a multiplicity of vertical coolant channels is described. Discrete, fissionable, fuel-bearing masses are suspended in the coolant channels. The fuel bearing masses contain from 1 to 4 wt.% U^{235}. The channels are arranged so that a gaseous coolant can be continuously

passed through them. Means to control the reactivity of the active portion are also given. The principal fuel constituent is UO_2. The moderator is graphite; the coolant is helium. Each channel is provided with equally spaced guiding recesses for engaging hangers. Locking means are provided for at least one location of each channel to prevent fuel hangers from sliding with recesses. (N.W.R.)

17809 IMPROVEMENTS IN OR RELATING TO GIRDLE LINKS. (to Commissariat à l'Énergie Atomique). British Patent 867,464. May 10, 1961.

A description of girdle links for securing a vertical stack of moderator units in a nuclear reactor is given. The girdle consists of a frame, a plurality of compression springs carried by and spaced along the frame, and a shoe movable against the springs in a plane normal to the axes of articulation of the hinge members for engaging the vertical stack. The frame consists of two hinge members positioned at respective ends of the frame for receiving hinge pins for connecting to two other links. (N.W.R.)

17810 FUEL FOR NEUTRONIC REACTORS AND PROCESS OF MAKING. Bernard M. Abraham and Howard E. Flotow (to U. S. Atomic Energy Commission). U. S. Patent 2,982,708. May 2, 1961.

A fuel material is offered for nuclear reactors consisting of $UO_{2.00}$ suspended in a sodium-containing liquid metal.

17811 NEUTRONIC REACTOR DESIGN TO REDUCE NEUTRON LOSS. F. T. Mills (to U. S. Atomic Energy Commission). U. S. Patent 2,982,709. May 2, 1961.

A nuclear reactor construction is described in which an unmoderated layer of the fissionable material is inserted between the moderated portion of the reactor core and the core container steel wall which is surrounded by successive layers of pure fertile material and fertile material having moderator. The unmoderated layer of the fissionable material will insure that a greater portion of fast neutrons will pass through the steel wall than would thermal neutrons. As the steel has a smaller capture cross-section for the fast neutrons, then greater numbers of the neutrons will pass into the blanket thereby increasing the over-all efficiency of the reactor.

17812 FOOD IRRADIATION REACTOR. Carl F. Leyse and Glen E. Putnam (to U. S. Atomic Energy Commission). U. S. Patent 2,982,710. May 2, 1961.

An irradiation apparatus is described. It comprises a pressure vessel, a neutronic reactor active portion having a substantially greater height than diameter in the pressure vessel, an annular tank surrounding and spaced from the pressure vessel containing an aqueous indium^{115} sulfate solution of approximately 600 grams per liter concentration, means for circulating separate coolants through the active portion and the space between the annular tank and the pressure vessel, radiator means adapted to receive the materials to be irradiated, and means for flowing the indium^{115} sulfate solution through the radiator means.

17813 SYSTEM FOR UNLOADING REACTORS. Alonzo C. Rand, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,982,711. May 2, 1961.

An unloading device for individual vertical fuel channels in a nuclear reactor is shown. The channels are arranged in parallel rows and underneath each is a separate supporting block on which the fuel in the channel rests. The blocks are mounted in contiguous rows on an array of parallel pairs of tracks over the bottom of the reactor. Oblong hollows in the blocks form a continuous passageway through the middle of the row of blocks on each pair of tracks. At the end of each passageway is a horizontal grappling rod with a T- or L-extension at the end next to the reactor of a length to permit it to pass through the oblong passageway in one position, but when rotated ninety degrees the head will strike one of the longer sides of the oblong hollow of one of the blocks. The grappling rod is actuated by a controllable reciprocating and rotating device which extends it beyond any individual block desired, rotates it and retracts it far enough to permit the fuel in the vertical channel above the block to fall into a handling tank below the reactor.

17814 HETEROGENEOUS NUCLEAR REACTOR EMPLOYING SMALL UNCLAD BODIES OF FISSIONABLE MATERIAL AS FUEL. Herbert H. Hyman and Joseph J. Katz (to U. S. Atomic Energy Commission). U. S. Patent 2,983,658. May 9, 1961.

A nuclear reactor in which fuel pellets are continuously dissolved in a moderator liquid is described. The fuel pellets are fed into the top of elongated baskets which are submerged in moderator liquid, and a portion of the moderator liquid is continuously withdrawn and processed to recover reaction products.

17815 NEUTRONIC REACTOR BURIAL ASSEMBLY. Michael Treshow (to U. S. Atomic Energy Commission). U. S. Patent 2,983,659. May 9, 1961.

A burial assembly is shown whereby an entire reactor core may be encased with lead shielding, withdrawn from the reactor site and buried. This is made possible by a five-piece interlocking arrangement that may be easily put together by remote control with no aligning of bolt holes or other such close adjustments being necessary.

17816 FUEL ELEMENT FOR NUCLEAR REACTORS. C. H. Bassett (to U. S. Atomic Energy Commission). U. S. Patent 2,983,663. May 9, 1961.

A nuclear reactor fuel element comprising high density ceramic fissionable material enclosed in a tubular cladding of corrosion-resistant material is described. The fissionable material is in the form of segments of a tube which have cooperating tapered interfaces which produce outward radial displacement when the segments are urged axially together. A resilient means is provided within the tubular housing to constantly urge the fuel segments axially. This design maintains the fuel material in tight contacting engagement against the inner surface of the outer cladding tube to eliminate any gap therebetween which may be caused by differential thermal expansion between the fuel material and the material of the tube.

17817 FUEL ELEMENT FOR NUCLEAR REACTORS. C. H. Bassett (to U. S. Atomic Energy Commission). U. S. Patent 2,984,613. May 16, 1961.

A fuel element particularly adapted for use in nuclear reactors of high power density is offered. It has fissionable fuel pellet segments mounted in a tubular housing and defining a central passage in the fuel element. A burnable poison element extends through the central passage, which is designed to contain more poison material at the median portion than at the end portions thereby providing a more uniform burnup and longer reactivity life.

17818 OVERALL CONTROL SYSTEM FOR HIGH FLUX PILE. Henry W. Newson, N. C. Durham, Eugene P. Wigner, N. J. Princeton, and Elbert P. Epler (to U. S. Atomic Energy Commission). U. S. Patent 2,985,574. May 23, 1961.

A control system is given for a high flux reactor incorporating an anti-scram control feature whereby a neutron absorbing control rod acts as a fine adjustment while a neutron absorbing shim rod, actuated upon a command received from reactor period and level signals, has substantially greater effect on the neutron level and is moved prior to

scram conditions to alter the reactor activity before a scram condition is created. Thus the probability that a scram will have to be initiated is substantially decreased.

17819 NEUTRONIC REACTOR STRUCTURE. Alvin M. Weinberg and Harcourt C. Vernon (to U. S. Atomic Energy Commission). U. S. Patent 2,986,508. May 30, 1961.

A neutronic reactor is described. It has a core consisting of natural uranium and heavy water and having a K-factor greater than unity which is surrounded by a reflector consisting of natural uranium and ordinary water having a K-factor less than unity.

17820 FUEL ELEMENT FOR A NUCLEAR REACTOR. J. G. Duffy, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,986,509. May 30, 1961.

A lattice-type fissionable fuel structure for a nuclear reactor is offered. The fissionable material is formed into a plurality of rod-like bodies each encased in a fluid-tight jacket. A plurality of spaced longitudinal fins are mounted on the exterior of and extend radially from each jacket, and a portion of the fins extends radially beyond the remainder of the fins. A collar of short length for each body is mounted on the extended fins for spacing the bodies, and adjacent bodies abut each other through these collars. Should distortion of the bodies take place, collapse of the outer fins is limited by the shorter fins thereby insuring some coolant flow therethrough at all times.

Power Reactors

17821 (AGN-8015) SULFUR-COOLED POWER REACTOR STUDY. Final Report. D. R. Sawle (Aerojet-General Nucleonics, San Ramon, Calif.). Dec. 1960. Contract AT (04-3)-251. 64p.

The corrosion and heat transfer characteristics of boiling sulfur were studied in order to evaluate the feasibility of using a boiling sulfur cycle to extract energy from a reactor. Work on the program included a literature survey of corrosion studies, capsule corrosion tests, dynamic loop corrosion tests, and boiling heat transfer experiments. (auth)

17822 (AGN-TM-387) ARMY GAS COOLED REACTOR SYSTEMS PROGRAM. THE GCRE CONTROL ROD SYSTEM. James M. Janis and R. H. Chesworth (Aerojet-General Nucleonics, San Ramon, Calif.). Mar. 1961. Contract AT(10-1)-880. 40p.

The design modifications are described which were made in the control rod system in the Gas Cooled Reactor Experiment to permit reliable, stable, maintenance-free operation of the rods. (D.L.C.)

17823 (AN-176) CONCEPTUAL DESIGN AND INITIAL RADIOLOGICAL SAFETY STUDY FOR A PULSED NUCLEAR REACTOR. Final Report. (Aerojet-General Nucleonics, San Ramon, Calif.). Apr. 18, 1960. Contract DA-04-200-509-ORD-1037. 13p.

Includes AN-177: ORDNANCE PULSED EXPERIMENTAL REACTOR ASSEMBLY. Fourth Monthly Report, March 1, 1960–April 19, 1960.

The report consists of a summary letter with two enclosures. Enclosure 1 (AN-177) includes discussions on: the contract schedule; machine calculations and safety in neutronics; mechanical design changes and simplifications; materials testing; control instrumentation; facility design; and the hazards report. Enclosure 2 summarizes the estimated costs for the remainder of the OPERA program up to the initial operation of the reactor. (B.O.G.)

17824 (APAE-85) EXPERIMENTS AND ANALYSIS FOR SM-1 CORE II WITH SPECIAL COMPONENTS. D. H. Lee, ed. (Alco Products, Inc., Schenectady, N. Y.). [1961]. Contract AT(30-1)-2639. 162p.

A summary of analytical and experimental work performed on SM-1 Core II, with special components is presented. The effects of these special assemblies upon power distribution and core reactivity were calculated and compared to experimental measurements. A thermal analysis was conducted to determine steady state and transient performance of the special test components of the core as well as some of the hotter standard Core II components. Experimental work discussed includes individual reactivity effects of all the special elements and the total effect of all of the elements. Power mappings were also made and are reported. (auth)

17825 (APDA-142) REMOVAL OF SODIUM FROM CORE SUBASSEMBLIES WITH WHITE OIL AND ULTRASONICS. Z. R. Kanaan and C. R. Nash (Atomic Power Development Associates, Inc., Detroit). Mar. 1961. 46p.

A method for removing sodium from fuel and blanket subassemblies that have been irradiated in the Enrico Fermi Atomic Power Plant reactor is described. In this method, the subassemblies are flushed with white oil aided by ultrasonic agitation, and the sodium is carried away from the surfaces of the subassemblies by the oil. Data gathered from experimental studies of the method are described; conceptual flow diagrams, materials balance sheets and equipment arrangements applicable to the Fermi plant are discussed; and sodium cleaning methods currently used are summarized. (D.L.C.)

17826 (APEX-585) RUNAWAY ANALYSIS FOR A GAS-COOLED REACTOR. Richard A. Becker (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1960. Contracts AT(11-1)-171 and AF33(600)-38062. 93p.

An IBM 704 digital computer program is presented that solves numerically and simultaneously the equations that describe gross reactor behavior under runaway conditions. Fuel element vaporization and expulsion is the chief shutdown mechanism. It is described by assuming a model of a simple convergent nozzle for the flow of fuel element vapor from the reactor. However, other shutdown mechanisms may also be used. This program is a unification, modification, and modernization of two existing ANPD IBM 704 programs, No. 31 and No. 129, which in part deal with the same subject. (auth)

17827 (BAW-1183) FINAL REPORT COVERING HOT EXPONENTIAL EXPERIMENTS USING GENERAL ELECTRIC MARITIME FUEL PINS. L. G. Barrett (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Jan. 1960. Contract AT(30-1)-2474. 244p.

Exponential experiments were conducted using General Electric Maritime fuel pins arranged in cylindrical geometry for pin pitch spacings of 0.770 in. and 0.789 in. These experiments were performed at various temperatures over the range from ambient to 476°F. Radial and axial neutron flux traverses were made using gold wires. In general, the gold wires were cadmium covered, but in a few cases bare wires were used. A core was also constructed which used G. E. fuel pins located on a 0.780-in. pitch spacing. The core simulated the Maritime reference design in regard to the dimensions and materials used in the can walls, control rod, water gap, and rod follower. Thermal neutron flux traverses were made using dysprosium–aluminum wires through a boron–stainless steel control rod blade, the control rod water gap, the stainless steel can wall, a flow

block, the Zircaloy rod follower blade, and also diagonally across the center of the rod follower. These measurements were also made over a wide range of temperatures. The data obtained from these measurements are presented in both tabular and graphical form. (auth)

17828 (CVNA-65) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, JULY–AUGUST–SEPTEMBER 1960. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). 215p.

A Fortran code (Kernmat) for the computation of the effective multiplication factor and absorptions in the components of a heterogeneous reactor based on the heterogeneous methods of small source theory was developed. Refinements were made to incorporate in the HYDNA code the calculation of the void fraction in the local boiling region and the transition region between local and bulk boiling. A study was made to determine the heat sources in the CVTR and the spatial distribution of these sources. The CVTR Phase I-B tests were run in Loop D. These tests were primarily intended to provide a comparison between a three and four thermal baffle design and to further assess the problem of by-pass leakage between the baffles and the pressure tube wall. A new arrangement for sealing the thermal baffles to the pressure tube wall was evolved for the Phase II tests. The new concept employs a ball-cone type seal in the pressure tube extension. This new seal concept also eliminates the need of integral latch arms in the shield plug and permits it to be made in one piece. A full-size Type 410 stainless steel–Zircaloy-2 Conoseal joint cracked while undergoing thermal cyclic tests. Careful inspection revealed that a circumferential crack (270°) had developed between the 410 stainless steel and the 309 stainless steel buttering on the sleeve. It was concluded that microcracks existed in the assembly prior to test in the region of failure and were instrumental in the failure. The thermal baffle test facility was adapted with high pressure fittings and flanges to allow testing of thermal baffle arrangements at higher temperatures. The autoclave selected for the facility will also be modified. To aid in the evaluation of a ceramic baffle as an alternate to the present CVTR baffle design, three samples were formed by swaging a tube filled with ZrO_2 powder. The samples were defected in the clad and put in an autoclave for high temperature water tests. Analysis of the water after the tests indicated that very small quantities of ZrO_2 were deposited in the water. Fabrication of the model U-tubes, heater rods, the venturi, orifice plates and void fraction chambers for the hydrodynamic stability tests was completed. Fabrication and installation of the apparatus for measuring the thermal resistance between the fuel pellets and the cladding was completed. Thermocouples were found to be out of tolerance and some were returned to the manufacturer for an error analysis or repair. All data from the first series of mixing studies were analyzed statistically. A fuel assembly with fuel rods wire wrapped on a 12-inch pitch produced slightly more mixing than a fuel assembly having fuel rods wrapped on a 15-inch pitch. The in-pile loop at WTR was completed and tests were performed in preparation for placing the loop in operation. The performance of the loop was satisfactory including 58 of the 64 loop thermocouples. The results of the Conoseal gasket crevice corrosion experiments to date indicate no serious problem at the 300 to 567°F CVTR operating conditions. Because of difficulties developed in air cooling the side and bottom thermal shields, it was recommended that these shields be cooled by water coils sandwiched between slabs of steel. The critical experiment has thus far given information concerning control rod worth, heavy water worth, critical size of a 2.0% enriched, half-height core, critical size of a 1.1% enriched full-height core, coolant void coefficients, flux plots and the worth of black and grey control rods in a two-region, full-height core. (auth)

17829 (DLCS-1370201) PWR CORE HANDLING EQUIPMENT. Test Results (T-550091-0) Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 30, 1961. 45p.

A test was conducted in which the PWR Fuel Assembly Extraction Tool was operated in dry pit prior to the actual refueling of the reactor in order to determine if the extraction tool would perform several loading operations. The tool functioned satisfactorily. Deficiencies which became evident during the course of the test were rectified prior to actual refueling operations. The deficiencies and the methods used to connect them are described. Data obtained during the test are presented in tabular form. (M.C.G.)

17830 (DLCS-1560109) XENON TRANSIENT TESTS. CORE I, SEED 2, EFPH 1565.4. Section 1. Test Results T-612081. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 30, 1961. 41p.

Tests were carried out to determine if there was sufficient excess reactivity present in the core to override a peak xenon transient and to obtain data for rod worth calculations. Upon completion of 1565.4 EFPH of plant operation of Core I, Seed 2, there was sufficient reactivity to override the peak xenon transient imposed by a rapid shutdown from an average reactor power level of 102.65%. The override occurred 8 hr and 46 min after shutdown with Group I control rods withdrawn to 69 in. and Group II control rods controlling, withdrawn to 44.75 in. Rod Group III and Group IV were fully inserted. (M.C.G.)

17831 (DP-585) HEAVY WATER MODERATED POWER REACTORS. Progress Report, January 1961. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Mar. 1961. Contract AT(07-2)-1. 47p.

At the end of January 1961, construction of the Heavy Water Components Test Reactor (HWCTR) was 50% complete. Installation of process equipment in the reactor building was started. Measurements were made in an exponential facility of the reactivity effects of D_2O coolant voids in a fuel assembly comprising four concentric tubes of natural uranium metal. The results support previous conclusions to the effect that a boiling D_2O reactor fueled with such assemblies would not be stable. Further buckling data on lattices of uranium oxide rods in D_2O were obtained from critical substitution experiments. Two experimental assemblies that contained short Zircaloy-clad tubes of swaged uranium oxide apparently failed during irradiation in a Savannah River reactor and were discharged. Studies directed toward identification of the causes and mechanism of failure are in progress. Measurements were made of the hydrodynamic stability of boiling water flow inside an electrically heated tube to determine the amount of upstream orificing that would be required to ensure flow stability in the fuel assemblies of a boiling D_2O reactor. (auth)

17832 (DP-595) HEAVY WATER MODERATED POWER REACTORS. Progress Report, February 1961. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Apr. 1961. Contract AT(07-2)-1. 30p.

Construction of the Heavy Water Components Test Reac-

tor (HWCTR) is 58% complete. The installation of process equipment, piping, conduit, and instrumentation in the reactor building was continued. The computer code that is to be used for design and cost computations to define optimum designs of heavy water power reactors is about 75% complete for liquid-D_2O-cooled reactors fueled with tubes of uranium metal or uranium oxide. The part of the code that is concerned with design of the reactor core was completed and is described. Measurements in the Process Development Pile (PDP) of the reactivity effects of D_2O coolant voids in fuel assemblies of uranium metal tubes were in good agreement with the results of earlier exponential experiments. The experimental data show that large positive reactivity effects result from coolant voids, and thereby confirm previous conclusions that boiling-D_2O-cooled power reactors fueled with assemblies of uranium metal tubes probably would not be stable. (auth)

17833 (GEAP-3166) RWE CONTROL AND TRANSIENT PERFORMANCE. M. A. Head (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 5, 1959. 36p.

The RWE reactor was studied with the aid of an analog computer to determine its control and transient performance. A study was made of the reactor pressure regulator, the reactor response to load demands, the safety valve bypass, and secondary relief valve requirements. The method of analysis used was to determine a set of differential equations to describe the dynamic components of the plant. (M.C.G.)

17834 (GNEC-164(Del.)) GAS-COOLED REACTOR PROJECT. Progress Report No. 8, September 1, 1960–February 28, 1961. (General Nuclear Engineering Corp., Dunedin, Fla.). Mar. 15, 1961. 218p.

The status of the design and development program for the ECNG-FWCNG prototype gas-cooled, heavy-water moderated, pressure-tube type reactor is discussed. Finned beryllium tubing, fabricated by hot extrusion, was produced in greater than 3-ft. lengths. Preliminary room temperature rupture tests of the tubing indicated mechanical strength exceeding that of smooth-wall tubing produced by the same methods. Other methods of producing the tubing are being developed. Programs for corrosion and mechanical testing of the beryllium tubing are described. Corrosion testing of zirconium alloys is continuing. The tube nozzle-closure seal was bench-tested successfully under static and thermal cycling conditions. The demonstrated leak rate was very low and it appeared that the seal could be re-used several times. Seamless Zircaloy-2 pressure tubes were produced. An optimization study of the reactor was begun to determine the lowest capital cost for the reactor consistent with good nuclear and mechanical design. Fuel-element design, materials development, reactor vessel and components, fuel handling, and systems analysis are discussed. (M.C.G.)

17835 (NP-10096) PROCEEDINGS OF NUCLEONICS IN FLIGHT SYMPOSIUM, MARCH 28-29, 1961, DALLAS, TEXAS. (American Nuclear Society. North Texas Section, Dallas). 197p.

Proceedings of the Nucleonics-in-Flight Symposium are presented. Summaries of the papers given are included under the following headings: physics and control of reactors for flight propulsion; nuclear rockets, ramjets, and auxiliary power; fuels and materials; shielding; heat transfer and fluid flow; radiation damage, activation, and space radiation; and reactor safety. (M.C.G.)

17836 (PRDC-TR-42) MONTHLY TECHNICAL REPORT [ON APDA ACTIVITIES], DECEMBER 1960. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 22p.

Research and development activities on the Fermi Fast Breeder Reactor are summarized in terms of core design, materials and metallurgy, nuclear engineering, health physics, mechanical handling, electrical and instrumentation systems, liquid metal and steam systems, and test operations. Results of the airborne dust sampling and analysis program are given. (M.C.G.)

17837 (TID-12329) RADIATION SURVEY OF THE REACTOR VESSEL HEAD. CORE I, SEED 2, RNI-39. Test Results. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 24, 1961. 16p. (DLCS-3050104; DLCS-3050105; DLCS-3050106; DLCS-3050107)

A radiation survey was made of the reactor vessel head and the magnitude of the radiation determined at specific intervals after shutdown of the reactor from an extended power operation. The radiation level was found to increase from the 4th to 7th performance of this test. The radiation measurements ranged from 16 to 400, 12 to 1000, 10 to 650, and 10 to 1000 mr/hr for the tests. The increase in the radiation level from the 4th to the 7th test was assumed to be due to the system being operated without purification for test purposes and to the buildup of crud through normal operation. The highest radiation levels in each test were obtained at the control rod drive mechanism housings. This was assumed to be due to the multiport valve being in the same location. (M.C.G.)

17838 (TID-12454) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD NOVEMBER 1, 1959 TO JANUARY 31, 1960. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Feb. 15, 1960 41p. (CISE-R-18) AEC 12/Euratom 110

The program of study of steam-water mixtures as coolants for light water moderated power reactors is presented. Included is description of a program to obtain data on burnout, heat transfer, and pressure drop mechanisms in fog flow at medium and high pressures. A study of flow stability in fuel channels and corrosion of fuel element cladding is also planned. (J.R.D.)

17839 (TID-12455) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD FEBRUARY 1, 1960 TO APRIL 30, 1960. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). May 15, 1960. 19p. (CISE-R-20) AEC 12/Euratom 110

Activities were directed mainly toward completion of three experimental loops. Modification of the heat transfer facility is reported so that it is no longer dependent on the Emilia Power Station. Assembly and testing of the corrosion and erosion loop are also reported. (J.R.D.)

17840 (TID-12456) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD MAY 1 TO JULY 31, 1960. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Aug. 31, 1960. 20p. (CISE-R-24) AEC 12/Euratom 110

Work was devoted mainly to operation of the heat transfer and flow stability loops. Heat transfer data are included. Various modifications are reported during operation of the flow stability loop. (J.R.D.)

17841 (TID-12457) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD AUGUST 1 TO OCTOBER 31, 1960. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Nov. 15, 1960. 12p. (CISE-R-28) AEC 12/Euratom 110

The majority of the effort during the period was expended in heat transfer experiments in annular ducts, collection

and elaboration of heat transfer data obtained with round tubes, testing of instrumentation for flow stability studies, and modification and testing of the corrosion and erosion loop. (J.R.D.)

17842 (TID-12458) CAN-1 PROGRESS REPORT FOR THE PERIOD NOVEMBER 1 TO DECEMBER 31, 1960. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Feb. 1, 1961. 12p. (CISE-R-32) AEC 12/Euratom 110

Progress is reported on heat transfer experiments in annular ducts, refined experiments on flow distribution and film thickness, and corrosion experiments on stainless steel and Zircaloy. (J.R.D.)

17843 (TID-12459) RESULTS OF WET STEAM COOLING EXPERIMENTS: PRESSURE DROP, HEAT TRANSFER AND BURNOUT MEASUREMENTS IN ANNULAR TUBES WITH INTERNAL AND BILATERAL HEATING. N. Adorni, S. Bertoletti, J. Lesage, C. Lombardi, G. Peterlongo, G. Soldaini, F. J. Weckermann, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Jan. 1961. 63p. (CISE-R-31) AEC 12/Euratom 110

Data are reported which were obtained with annular test elements internally and bilaterally heated with wet steam. (J.R.D.)

17844 (TID-12460) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD JANUARY 15, 1960 TO APRIL 15, 1960. PART A. TECHNICAL REPORT. (Ansaldo S. p. A., Genoa). May 10, 1960. 35p. (LAB-STU-1410) AEC 12/Euratom 110

Injection and separation problems connected with the preliminary design of a fog-coated and light-water moderated reactor are discussed. A loop constructed for the preliminary tests with air-water mixtures is described. The loop consists of water and gas inlet lines, mixer, flow tube, and separator. A preliminary study indicated that a mechanical centrifugal separator gave the best separation. Measurements using isokinetic, pitot, and capacitor probes are discussed. (M.C.G.)

17845 (TID-12461) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD APRIL 16, 1960 TO JULY 15, 1960. PART A. TECHNICAL REPORT. (Ansaldo S. p. A., Genoa). July 30, 1960. 14p. (LAB/STU/1426) AEC 12/Euratom 110

The low-pressure loop was completed and air-water mixing tests were carried out. Measurements of the axial molar air quality were made as a function of the distance from the mixer for the cases of water from the center and air from periphery and of air from the center and water from preiphery. The former case required a higher value for mixing length. The design of a high pressure loop was completed. (M.C.G.)

17846 (TID-12462) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD JULY 16, 1960 TO OCTOBER 15, 1960. PART A. TECHNICAL REPORT. (Ansaldo S. p. A., Genoa). Nov. 15, 1960. 39p. (LAB-STU-S/1433) AEC 12/Euratom 110

Preliminary air-water mixing experiments were performed with the low-pressure loop. A number of mixing nozzles were tested in order to determine the type of mixer which achieves a steady flow condition in the tube as soon as possible. It was assumed that these conditions are obtained when the axial quality of the mixture remains practically constant. Water pressure drop was found to affect strongly the stability of the axial quality whatever the test pressure. A general sketch and description of the high-pressure loop are also presented. (M.C.G.)

17847 (AEC-tr-4327) APPLICATION OF NUCLEAR PROPULSION IN AVIATION. J. Grzegorzewski. Translated by J. Woroncow from Wojskowy Przeglad Lotniczy, 13: No. 3, 24-32(Mar. 1960). 11p. (XDC-60-10-151)

A discussion is given of the study of various aspects of atomic aircraft engines. Basic information is presented on nuclear turbojet, turboprop, and ram-jet engines. Possible applications of atomic energy in rockets are discussed. A comparison is made of chemical and nuclear fuels. General discussions are given of shielding problems, safety, materials, ground servicing, landing, and vertical take-off. (auth)

17848 PRESENT STAGE OF DEVELOPMENT OF SODIUM–GRAPHITE REACTORS. R. J. Beeley (Atomics International, Canoga Park, Calif.). Atom u. Strom, 7: No. 3, 17-22(Mar. 1961). (In German)

The Sodium Graphite Reactor has a series of characteristics which makes it very suitable for utilization as a heat source for stationary power plants. The present state of development of the SGR is explained on the basis of the construction materials, structural constituents, and the general technology. (tr-auth)

17849 SELECTION OF THE BEST PARAMETERS FOR A NUCLEAR POWER STATION. A. Ya Kramerov. Atomnaya Energ., 10: 211-21(Mar. 1961). (In Russian)

A system of equations is derived for determining the optimum parameters for the production of nuclear electric power. It is assumed that the design, materials, type of installation, and its terminals have been selected and only the optimum construction and operating parameters are sought. General approximations of the cost relation to the parameters are analyzed, and operational limitations are considered. The equations can be applied in verifying the optimum parameters of a two-loop, non-boiling reactor with maximum fuel element temperatures. (tr-auth)

17850 A STUDY OF RADIOACTIVE PURITY OF THE ATMOSPHERIC AIR AND OF THE RIVER NEVA IN THE REGION USED FOR THE FITTINGOUT TRIALS OF THE ICEBREAKER "LENIN." Yu. V. Sivintsev, V. A. Knizhnikov, E. L. Telushkina, and A. D. Turkin. Atomnaya Energ., 10: 253-8(Mar. 1961). (In Russian)

The radiation levels in the central compartment and in the mast-section of the icebreaker, and in the air, water, flora, and fauna around the icebreaker were monitored during the fitting-out tests. The results showed highly effective safety factors for the personnel, the mooring area, and nearby ships. (tr-auth)

17851 REACTORS COOLED WITH SODIUM AND MODERATED WITH GRAPHITE. Henri Polak (North American Aviation S.A., Geneva), and Robert L. Loftness. Inds. atomiques, 5: No. 1-2, 37-50(1961). (In French)

The progressive evolution of sodium-cooled, graphite-moderated reactors up to the stage of a reactor for commercial power production is described. The fuel elements, construction materials, nuclear physics, and constituent elements are discussed. (J.S.R.)

17852 BURNUP EXPERIENCE IN EBWR. Joseph A. Thie (Argonne National Lab., Ill.). Nucleonics, 19: No. 5, 60-2(May 1961).

The properties and performance characteristics of EBWR after more than 8000 Mwd of core life are studied. The conditions of the boron-steel control rods and the U–Zr fuel elements are appraised. It is noted that observed changes in delayed-neutron fraction and temperature coefficient produce undesirable safety and dynamic behavior at about 16000 Mwd. (T.F.H.)

17853 DEPENDENCE OF THE COOLANT GAS OUTLET ON THE POWER CONSUMPTION IN GAS COOLED REACTORS. O. Machnig and R. Küster (BBC-Krupp, Mannheim, Ger.). Nukleonik, 3: 27-31(Mar. 1961). (In German)

The power of gas-cooled reactors is controlled by the coolant current. A completely power-independent coolant gas outlet temperature is not obtainable because of the temperature coefficient, rather an increase of the coolant temperature results from the downward adjusting of the power. By means of a perturbation addition, the effect was calculated from differential equations. In some diagrams, numerical results are represented. (tr-auth)

17854 BOILING WATER REACTOR WITH STEAM SUPERHEATER. (to Societe Belge pour l'Industrie Nucleaire). Belgium Patent 581,960. Aug. 25, 1959. (In French)

Internally and externally clad tubular fuel elements allow a dual circulation of the coolant which is heated, vaporized, and superheated. Because of the design of the core and of the pressure vessel, the coolant acts as a moderator, as a reflector, and as a screen. (EURATOM)

17855 STEAM GENERATOR FOR GAS-COOLED REACTORS. (to Vereinigte Kesselwerke A. G.). Belgian Patent 583,451. Oct. 9, 1959. (In French)

A cylindrical steam generator is located in the same pressure vessel as the reactor. The generator has layers of horizontal curved tubes whose geometrical arrangement is responsible for even heating of the cooling gas. Sectionalized design of the heat exchanger increases safety. (EURATOM)

17856 DEVICE FOR THE PRODUCTION OF SUPERHEATED STEAM IN A REACTOR. (to Brown, Boveri et Cie, A. G.). Belgium Patent 583,878. June 6, 1959. (In French)

A boiling water reactor is described that has tubular fuel elements. The outside walls transmit enough heat to vaporize the circulating water; the saturated steam then flows inside the tubes where it is superheated. In each fuel channel, elements are arranged in the following order: an outer moderating material section with protective lining inside its cylindrical bore, an annular channel, a layer of moderating material lined or canned on both sides, an annular channel, and a hollow cylindrical fuel element. (EURATOM)

17857 GAS-COOLED REACTOR WITH HEAT EXCHANGER FOR STEAM PRODUCTION. (to Brown, Boveri et Cie, A. G.). Belgian Patent 586,781. July 22, 1960. (In French)

For safety reasons, the heat exchanger of the reactor under consideration is separated from the core by a graphite wall acting as a reflector. A passage is provided through this wall for the cooling gas. In case of over-pressure due to a fault either in the core or in the heat exchanger, a safety valve is provided that opens automatically and allows the cooling gas to flow through a cooler and a scrubber before being fed back into the reactor core. The pressure vessel consists of 2 thicknesses of material separated by a layer of air; the activity of this air is kept below the maximum permissible level so that the cooling equipment and the filters contained in the pressure vessel can be easily serviced. Surrounding the pressure vessel is a biological shield. (EURATOM)

17858 MERCHANT MARINE SHIP REACTOR. J. F. Mumm, D. C. North, Jr., H. R. Rock, and D. K. Geston (to U. S. Atomic Energy Commission). U. S. Patent 2,982,713. May 2, 1961.

A nuclear reactor is described for use in a merchant marine ship. The reactor is of pressurized light water cooled and moderated design in which three passes of the water through the core in successive regions of low, intermediate, and high heat generation and downflow in a fuel region are made. The foregoing design makes a compact reactor construction with extended core life. The core has an egg-crate lattice containing the fuel elements confined between a lower flow baffle and upper grid plate, with the latter serving also as part of a turn-around manifold from which the entire coolant is distributed into the outer fuel elements for the second pass through the core. The inner fuel elements are cooled in the third pass.

Production Reactors

17859 (HW-25261(Del.)) DIFFUSION LENGTH MEASUREMENTS IN THE DR AND H PILES. E. B. Montgomery (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1952. Declassified with deletions Mar. 3, 1960. Contract W-31-109-Eng-52. 27p.

Diffusion length and contamination tests were performed on both the DR and H piles after lay-up was completed and process tubes were installed. The irradiation of indium foils was used as the means of neutron detection in the DR test. BF_3 counters were used for the H test. The same Po–Be neutron source was used for both tests. The over-all diffusion length of the DR pile was determined to be 51.4 cm. This value was obtained by the application of the least squares method to 584 values. The over-all diffusion length of the H pile, based on least squares application to 889 values of neutron intensity, was determined to be 55.0 cm. No large region of low neutron flux was detected in either pile, indicating that no large volumes of lumped poisoning were present. (auth)

Research Reactors

17860 (CF-61-3-40) ROD DROP TESTS FOR THE BSR-II TRANSIENT AND CONTROL RODS. R. T. Santoro, T. F. Sliski, and J. R. Tallackson (Oak Ridge National Lab., Tenn.). Mar. 6, 1961. Contract W-7405-Eng-26. 15p.

Rod displacement was measured as a function of time for both the control and transient rods in the spring-accelerated modular control-rod drive for the Bulk Shielding Reactor II (BSR-II). The measurements were performed by dropping the rods from heights ranging from 1 to 12 in. above the seat position. A composite displacement curve was drawn for all BSR-II spring-loaded control rods. (D.L.C.)

17861 THE PEGASE REACTOR. R. Dautray. Énergie nucléaire, 3: 11-21(Jan.-Feb., 1961). (In French)

The principles used in the design of the Pegase Reactor, a research reactor for testing the behavior of fuel elements under irradiation, are discussed. The study of the reactor physics shows that the calculations are not sufficient to solve the problems set; some experiments will be made on a critical assembly of the same nuclear size as Pegase. The tests which have been made in the reactor, the research facilities, the fuel arrangement, the coolant circuits, and the auxiliary installations are described. (tr-auth)

17862 RAPSODIE. Georges Vendryes (Commissariat à l'Énergie Atomique, [Paris]). Energie nucléaire, 3: 25-46 (Jan.-Feb., 1961). (In French)

The fast-neutron high-flux reactor Rapsodie is greatly different from those which have been studied and constructed up to the present time in French nuclear centers. It will

use a concentrated fuel material (plutonium and enriched uranium) with sodium as heat transfer agent, and it will have no moderator. The objective and principal characteristics of Rapsodie are described. The reactor itself, the liquid circuits, installations for fuel element manipulation, and reactor control are then discussed. (tr-auth)

17863 THE SUBCRITICAL ASSEMBLY URANIE DESIGNED FOR INSTRUCTION. Alexis Bouchicot (Institut National des Sciences et Techniques Nucléaires). J. M. Thomas, and Henri Roquefort. Inds. atomiques, 5: No. 1-2, 65-9(1961). (In French)

A general description is given of the subcritical assembly Uranie which is designed for instruction in reactor physics. The vessel and fuel assembly, the neutron source, and the detection and measurement installations are briefly described. (J.S.R.)

WASTE DISPOSAL AND PROCESSING

17864 (DP-564) RADIOACTIVE WASTE MANAGEMENT AT THE SAVANNAH RIVER PLANT. J. Henry Horton (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1961. Contract AT(07-2)-1. 13p.

The radioactive waste management program in effect at the Savannah River Plant is described. Future plans to improve the program are outlined. Included is a schematic concept of a proposed mine-type installation for permanent storage of high level liquid waste. (auth)

17865 (IDO-22041) HYDROLOGY OF RADIOACTIVE WASTE DISPOSAL AT THE IDAHO CHEMICAL PROCESSING PLANT NATIONAL REACTOR TESTING STATION, IDAHO. Paul H. Jones (Geological Survey, Idaho Falls, Idaho). Feb. 1961. 16p.

Investigations designed to trace the movement of waste water in the ground reservoir in the ICPP area and to determine and evaluate factors attenuating its radioactivity were carried out. Borehole geophysical logging provided data that serve to identify the aquifers tapped and to describe some of their characteristics. Interbeds of scoria, cinders, flow breccia, and sediments were found to be the principal aquifers in a basalt terrane. Logs of water resistivity and temperature provided data on the salinity of water in the borehole. Waste water from the disposal wells tended to work from thin to thicker parts of the aquifer. Preferred direction of movements were to the southeast and southwest with no appreciable flow directly south. (M.C.G.)

17866 DECONTAMINATION METHODS. H. Stephan (Hahn-Meitner-Institut für Kernforschung, Berlin-Wannsee, Ger.). Kerntechnik, 3: 102-5(Mar. 1961). (In German)

For decontamination a degree of purity is required which goes much beyond the extent of cleanliness necessary in normal analytical work. A distinction can be made between physical and chemical decontamination methods. The factors determining the cost of these methods are reviewed. A survey of special decontamination media for various materials shows that there is no generally applicable decontamination medium. (tr-auth)

17867 THE SAFE DISPOSAL OF RADIOACTIVE WASTES. R. H. Burns (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Roy. Soc. Health J., 80: 214-19(July-Aug. 1960).

Methods used in Great Britain for the disposal of radioactive wastes are reviewed, and methods suggested for future disposal are discussed. It is pointed out that legislative control of disposal has been adequate, but conditions may alter in the future. The provisions of the proposed Radioactive Substances Bill are outlined. (C.H.)

17868 ATOMIC ENERGY WASTE. ITS NATURE, USE AND DISPOSAL. E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961. 432p. $14.00.

Separate abstracts have been prepared on 17 chapters covering various aspects of the nature, use, and disposal of radioactive waste. (C.H.)

17869 ALPHA EMITTERS IN REACTOR WASTES. H. A. C. McKay (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.99-108 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

The four α-emitters to be considered in waste disposal are Np^{237}, Pu^{238}, Am^{241}, and Cm^{242}. The formation of these isotopes, hazards due to fission products in waste solutions, hazards arising from the recycling of U^{235} fuel, hazards arising from Pu fuel, and hazards arising from natural U fuel are discussed. It is pointed out that, with one minor exception, no α emitter is ever likely to be a greater hazard than Sr^{90} in unseparated fission product wastes. In Sr^{90}-denuded wastes, α emitters become important, especially as regards airborne contamination. Data are tabulated on the most hazardous α-emitting nuclides under various conditions. (C.H.)

17870 THE LEGAL ASPECTS OF ATOMIC WASTE DISPOSAL AND TRANSPORT OF RADIOACTIVE MATERIALS. R. H. Burns (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.187-201 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

An act governing the handling of radioactive substances in Great Britain was passed in June, 1960, and is expected to exercise effective control over wastes from all users of radioactive materials in that country. Provisions of the act are outlined. The provisions are reviewed of the U. S. Atomic Energy Act of 1954, which establishes the basis for Federal control of atomic energy. The transport of radioactive materials is discussed from the standpoint of safety. (C.H.)

17871 SURVEY OF TREATMENTS CONSIDERED FOR LOW-ACTIVITY WASTES. C. B. Amphlett and D. C. Sammon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.205-40 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Methods used for the treatment of low-activity radioactive wastes are surveyed. Topics discussed include chemical methods, ion exchange, evaporation, the treatment of sludges, decontamination by biological methods, ground disposal, disposal of liquid waste into rivers, and sea disposal. 70 references. (C.H.)

17872 LOW-ACTIVITY TREATMENT IN LARGE-SCALE PRACTICE. C. B. Amphlett and D. C. Sammon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.241-56 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Methods are discussed for the large-scale treatment of low-activity radioactive wastes. Methods of waste disposal used at Chalk River, Oak Ridge National Laboratory, and Harwell are discussed in detail. (C.H.)

17873 WASTE TREATMENTS AT SOME HIGH-ACTIVITY PROCESSING PLANTS. K. Saddington (United Kingdom Atomic Energy Authority, Windscale, Cumb., Eng.). p.257-81 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Methods used for the large-scale treatment of high-activity radioactive wastes are discussed. The disposal methods used at Windscale, Dounreay, and Hanford are described in detail. The effluent problems arising from the operation of the reactors at these stations are also discussed, since the effluents from reactors are treated as part of the waste from the particular site. The effluents are divided into three groups according to activity. It is pointed out that they may vary widely in amount and chemical composition. Pro-

cedures are summarized for the treatment of wastes resulting from the processing of reactor fuel elements. Methods used for the treatment of wastes from the Bismuth Phosphate, Redox, and Purex Processes at Hanford are outlined. It is pointed out that a fundamental difference exists between the U.S. and U.K. approach to the storage of highly active liquid wastes. The U.K. policy is to store the acid concentrate in stainless steel tanks, while at Hanford the acid liquors are neutralized before dispatch to final storage tanks lined with mild steel. Cost factors of various treatment methods are also discussed briefly. (C.H.)

17874 CONVERSION OF HIGHLY ACTIVE WASTES TO SOLID PRODUCTS. C. B. Amphlett (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.282-307 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

The long half lives of certain nuclides, such as Cs^{137} and Sr^{90}, demand that safe storage be ensured for many centuries. Hazards may result from a leak in a storage tank, or heat generated by radioactive decay may cause boiling and the release of radioactive aerosols. Since tank storage is costly, many studies have been made of other methods. Methods based on ion exchange and those in which the waste is dried and converted to a ceramic body are described in detail. (C.H.)

17875 DISPERSION OF ACTIVITY FROM CHIMNEY STACKS. A. C. Chamberlain (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.308-23 of "Atomic Energy Waste. Its Nature, Use and Disposal." E. Glueckauf, ed. New York, Interscience Publishers Inc., 1961.

Factors restricting the release of radioactive aerial effluent are discussed. Hazards from inhalation, contamination of milk and other food, and the deposition of radioactive particles on the skin are discussed. Factors which affect the diffusion of particles from a stack are considered. Data are tabulated on the permissible emission of Ar^{41}, C^{14}, and I^{131} from stacks. (C.H.)

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